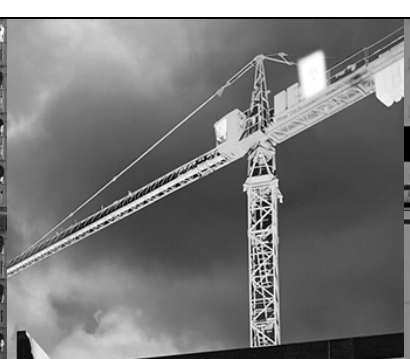
SEW EURODRIVE

Manual

IPOS$^{plus®}$ Positioning and Sequence Control System

Edition 11/2009

11645415 / EN



KKFU 144794 3
42G1

Contents

1 General Information 14
1.1 Structure of the safety notes 14
1.2 Liability for defects 15
1.3 Exclusion of liability 15
1.4 Copyright 15
2 Safety Notes 16
2.1 General information 16
2.2 Designated use 17
2.3 Target group 17
2.4 Programming errors 17
3 System Description 18
3.1 Introduction 18
3.1.1 Scope of this documentation 18
3.1.2 Creating programs 19
3.2 IPOS$^{plus®}$ – features 19
3.3 Controlling IPOS$^{plus®}$ units 22
3.3.1 Active control signal source 22
3.4 Technology options / application modules 22
3.4.1 Technology options 22
3.4.2 Application modules 23
3.5 Technical data 25
3.5.1 MOVIDRIVE® B 25
3.5.2 MOVITRAC® B 25
3.5.3 MQx 26
3.6 Reference documents 27
3.6.1 General manuals 27
3.6.2 Manuals for serial interfaces/fieldbuses 27
3.6.3 Manuals for synchronized axis movements 27
3.6.4 Manuals for application modules 27
3.6.5 Manuals for the MQx fieldbus interfaces 27
4 IPOS Variables 28
4.1 Introduction 28
4.2 Overview of the system variables 29
5 Task Management and Interrupts 40
5.1 Introduction 40
5.2 Task management for MOVIDRIVE® A and B 40
5.3 Tasks for MOVIDRIVE® A 43
5.4 Tasks for MOVIDRIVE® B 43
5.4.1 Processing time for task 1 / task 2 43
5.4.2 Task 3 44
5.4.3 Implementation information 44
5.4.4 Example 45

5.5 Interrupts ... 45
5.5.1 Example ... 46
5.6 Interrupts for MOVIDRIVE® A and B ... 46
5.6.1 Interrupt activation ... 46
5.6.2 Error interrupt ... 46
5.6.3 Touch probe DI02 interrupt ... 47
5.6.4 Timer0 interrupt ... 48
5.7 Variable interrupts with MOVIDRIVE® B ... 49
5.7.1 Calling up the variable interrupt ... 49
5.7.2 IPOS access to the internal interrupt control ... 50
6 Position Detection and Positioning ... 53
6.1 Encoder evaluation ... 53
6.2 Motor encoder (X15) ... 54
6.3 Encoder combinations ... 54
6.4 External encoder (X14) ... 57
6.4.1 Positioning on external encoder (X14) ... 57
6.4.2 Slip compensation with external encoder ... 57
6.5 SSI absolute encoder (DIP) ... 60
6.5.1 Startup ... 60
6.5.2 1. Select encoder type P950 ... 60
6.5.3 2. Set direction of rotation of the motor P35_ ... 61
6.5.4 3. Set counting direction P951 for the SSI absolute encoder ... 61
6.5.5 4. Set encoder scaling P955 ... 61
6.5.6 5. Set position offset P953 ... 61
6.5.7 6. Set Zero offset P954 ... 62
6.5.8 7. Set encoder factors P942 and P943 ... 62
6.5.9 8. Set P941 actual position source ... 62
6.6 Referencing ... 63
6.6.1 Type 0: Reference travel to zero pulse ... 67
6.6.2 Type 1: CCW end of the reference cam ... 67
6.6.3 Type 2: CW end of the reference cam ... 68
6.6.4 Type 3: CW limit switch ... 69
6.6.5 Type 4: CCW limit switch ... 69
6.6.6 Type 5: No reference travel ... 70
6.6.7 Type 6: Reference cam flush with CW limit switch ... 70
6.6.8 Type 7: Reference cam flush with CCW limit switch ... 71
6.6.9 Type 8: Without enable ... 72
6.7 Modulo function ... 73
6.7.1 Introduction ... 73
6.7.2 Operating principle ... 74
6.7.3 Travel strategies ... 77
6.7.4 Project planning ... 80
6.7.5 Project planning examples ... 80
6.7.6 Frequently asked questions ... 83

6.8 Cam controllers ... 84
6.8.1 Standard cam controller ... 85
6.8.2 Expanded cam controller ... 89

7 Position Detection via Binary Inputs ... 96
7.1 Types of built-in encoders ... 96
7.2 Principle of the position detection ... 96
7.3 Position detection with MOVIDRIVE® B ... 97
7.4 Position detection with MOVITRAC® B ... 98
7.5 Position detection with MQx ... 99
7.5.1 Proximity sensor evaluation ... 99
7.5.2 DI0 and DI1 terminal assignments ... 99
7.5.3 Position detection with built-in encoder ... 100
7.5.4 Encoder monitoring ... 100
7.5.5 Storing the actual position ... 100
7.5.6 Counter ... 101
7.5.7 Connecting the built-in encoders ... 101

8 IPOS$^{plus®}$ and Fieldbus ... 102
8.1 Introduction ... 102
8.2 Binary inputs and outputs ... 103
8.2.1 Fieldbus interface, DIO and DIP ... 103
8.3 Cyclical process data ... 103
8.3.1 Cyclical preset process data ... 103
8.3.2 Cyclical user-specific process data ... 104
8.4 Acyclical communication ... 105
8.5 Special features of communication via SBus ... 105
8.6 Special features of communication via RS-485 ... 106
8.7 Fieldbus control words and fieldbus status words ... 106

9 IPOS$^{plus®}$ and Synchronized Motion ... 107
9.1 Introduction ... 107
9.2 Speed synchronization via master/slave function ... 107
9.3 Synchronous operation with a DRS option card ... 107
9.3.1 Activating and deactivating the free running function ... 108
9.3.2 Setting the zero point for DRS11B ... 109
9.3.3 Activating and deactivating the offset function ... 111
9.3.4 Switching between positioning and synchronous operation ... 113
9.4 Synchronous operation with technology option "Internal synchronous operation" ... 115
9.4.1 Requirements ... 115
9.5 Synchronous operation with technology option "Cam" ... 116
9.5.1 Requirements ... 117

10 IPOS$^{plus®}$ for MOVITRAC® B – Characteristics ... 118
10.1 Requirements ... 118
10.2 Functionality ... 119

11 IPOS$^{plus®}$ for MQx – Characteristics ... 120
11.1 Introduction ... 120

11.2 Starting the programming tool ... 121
11.3 Sequence control system ... 121
11.4 Digital inputs and outputs ... 121
11.5 Values of the DIAG11 variable for the error IPOS ILLOP ... 122
12 P9xx IPOS Parameters ... 123
12.1 P90x IPOS reference travel ... 123
12.1.1 P900 Reference offset ... 123
12.1.2 P901 Reference speed 1 ... 124
12.1.3 P902 Reference speed 2 ... 124
12.1.4 P903 Reference travel type ... 124
12.1.5 P904 Reference travel to zero pulse ... 126
12.1.6 P905 Hiperface offset X15 ... 126
12.1.7 P906 Cam distance ... 126
12.2 P91x IPOS$^{plus®}$ parameters ... 127
12.2.1 P910 Gain X controller ... 127
12.2.2 P911/912 Positioning ramp 1/2 ... 127
12.2.3 P913/P914 Travel speed CW/CCW ... 127
12.2.4 P915 Velocity precontrol ... 127
12.2.5 P916 Ramp type ... 128
12.2.6 P917 Ramp mode ... 130
12.2.7 P918 Bus setpoint source ... 130
12.3 P92x IPOS monitoring ... 131
12.3.1 P920/P921 SW limit switch CW/CCW ... 131
12.3.2 P922 Position window ... 131
12.3.3 P923 Lag error window ... 131
12.3.4 P924 Positioning interruption detection ... 131
12.4 P93x IPOS$^{plus®}$ special functions ... 132
12.4.1 P930 Override ... 132
12.4.2 P931 IPOS CTRL.W Task 1 ... 132
12.4.3 P932 IPOS CTRL.W Task 2 ... 132
12.4.4 P933 Jerk time ... 132
12.4.5 P938 Speed task 1 ... 132
12.4.6 P939 Speed task 2 ... 133
12.5 P94x IPOS$^{plus®}$ encoder ... 134
12.5.1 P940 IPOS variable edit ... 134
12.5.2 P941 Actual position source ... 134
12.5.3 P942/P943 Encoder factor numerator/denominator ... 134
12.5.4 P944 Encoder scaling ext. encoder ... 135
12.5.5 P945 Synchronous encoder type (X14) ... 135
12.5.6 P945 Synchronous encoder counting direction (X14) ... 136
12.5.7 P947 Hiperface offset X14 ... 136
12.5.8 P948 Automatic encoder replacement detection ... 137

12.6 P95x absolute encoder (SSI) ... 138
12.6.1 P950 Encoder type ... 138
12.6.2 P951 Counting direction ... 138
12.6.3 P952 Cycle frequency ... 139
12.6.4 P953 Position offset ... 139
12.6.5 P954 Zero offset ... 139
12.6.6 P955 Encoder scaling ... 139
12.6.7 P956 CAN encoder baud rate ... 139
12.7 P96x IPOS$^{plus®}$ modulo function ... 140
12.7.1 P960 Modulo function ... 140
12.7.2 P961 Modulo numerator ... 140
12.7.3 P962 Modulo denominator ... 140
12.7.4 P963 Modulo encoder resolution ... 140
12.8 P97x IPOS synchronization ... 141
12.8.1 P970 DPRAM synchronization ... 141
12.8.2 P971 Synchronization phase ... 141
13 Compiler – Editor ... 142
13.1 Technical features ... 142
13.2 First steps ... 143
13.2.1 Step 1: Starting IPOS$^{plus®}$ Compiler with MOVITOOLS® MotionStudio ... 143
13.2.2 Step 2: Creating a new project ... 145
13.2.3 Step 3: The first IPOS$^{plus®}$ program ... 148
13.2.4 Step 4: Compiling and starting the IPOS$^{plus®}$ program ... 151
13.3 Settings for the IPOS$^{plus®}$ Compiler ... 154
13.4 Search function ... 157
13.5 Creating a new project ... 158
13.5.1 Project properties ... 158
13.5.2 Defining the program structure ... 159
13.6 Saving a project ... 161
13.7 Setting up a project management structure ... 162
13.8 Opening a project ... 164
13.9 Handling projects with MOVIDRIVE® B ... 164
13.9.1 Saving a project in the inverter ... 164
13.9.2 Loading a project from the inverter ... 165
13.9.3 Calling up a project from the inverter ... 165
13.10 Compiling a project ... 166
13.11 Compiling and downloading ... 167
13.12 Starting a program ... 167
13.13 Stopping a program ... 167
13.14 Comparison with unit ... 167
13.15 Debugger ... 168
13.16 Variable window ... 169
13.17 Program information ... 171
13.18 Entering instructions ... 172
13.19 Comments ... 173

13.20 Overview of the icons ... 174
14 Compiler – Programming ... 175
14.1 Preprocessor ... 176
14.2 Preprocessor statements ... 176
14.3 #include ... 178
14.4 Include folders ... 179
14.5 #define ... 179
14.6 #undef ... 180
14.7 #declare ... 181
14.8 SEW standard structures ... 182
14.9 User-defined structures ... 184
14.10 long ... 186
14.11 initial long ... 186
14.12 #pragma ... 187
14.13 Explanation of const.h and io.h / constb.h and iob.h ... 188
14.14 Identifiers ... 190
14.15 Constants ... 190
14.16 IPOS$^{plus®}$ variables in the compiler ... 191
14.16.1 Example ... 191
14.17 Declaration of global variables ... 191
14.18 Indirect addressing – pointer ... 192
14.19 numof() ... 193
15 Compiler – Operators ... 194
15.1 Order of priority of operators ... 194
15.2 Unary operators ... 195
15.3 Binary operators ... 196
15.3.1 Example ... 196
15.4 Ternary operators ... 196
15.4.1 Example ... 196
16 Compiler – Constructions ... 197
16.1 if...else ... 197
16.1.1 Syntax ... 197
16.2 for ... 198
16.2.1 Syntax ... 198
16.3 while ... 199
16.3.1 Syntax ... 199
16.4 do...while ... 200
16.4.1 Syntax ... 200
16.5 switch...case...default ... 202
16.5.1 Syntax ... 202
16.6 return ... 203

17 Compiler – Functions 204
17.1 User-defined functions 204
17.2 Overview of commands for standard functions 205
17.2.1 Standard bit functions 205
17.2.2 Standard communication functions 206
17.2.3 Standard positioning functions 206
17.2.4 Standard program functions 206
17.2.5 Standard setting functions 207
17.2.6 Special standard unit functions 207
17.3 Standard functions 208
17.3.1 _AxisStop 208
17.3.2 _BitClear 209
17.3.3 _BitMove 209
17.3.4 _BitMoveNeg 209
17.3.5 _BitSet 210
17.3.6 _Copy 210
17.3.7 _FaultReaction 210
17.3.8 _GetSys 211
17.3.9 _Go0 217
17.3.10 _GoAbs 218
17.3.11 _GoRel 219
17.3.12 _InputCall 220
17.3.13 _Memorize 221
17.3.14 _MoviLink 222
17.3.15 _MovCommDef 227
17.3.16 _MovCommOn 229
17.3.17 _Nop 229
17.3.18 _SBusCommDef 230
17.3.19 _SBusCommOn 234
17.3.20 _SBusCommState 234
17.3.21 _SetInterrupt 235
17.3.22 _SetSys 236
17.3.23 _SetTask 238
17.3.24 _SetTask2 239
17.3.25 _SetVarInterrupt 240
17.3.26 _SystemCall 241
17.3.27 _TouchProbe 242
17.3.28 _Wait 243
17.3.29 _WaitInput 243
17.3.30 _WaitSystem 244
17.3.31 _WdOff 244
17.3.32 _WdOn 245
18 Compiler – Examples 246
18.1 Setting bits and output terminals 246
18.2 Clearing bits and output terminals 247

18.3 Querying bits and input terminals 248
18.3.1 Testing single bits 248
18.3.2 Testing several bits 248
18.4 Querying an edge 249
18.4.1 Example 1 249
18.4.2 Example 2 251
18.5 Value of a number 252
18.6 MoviLink command 253
18.6.1 Reading an internal unit parameter 253
18.6.2 Writing a variable via SBus 254
18.6.3 Reading a parameter via SBus 255
18.7 SCOM communication 256
18.7.1 Receiver 256
18.7.2 Sender 257
18.8 Touch probe interrupt processing 258
18.9 State machine, fieldbus control with emergency mode 261
18.9.1 Mode 0 265
18.9.2 Mode 1 265
18.9.3 Mode 2 265
18.9.4 Mode 3 265
18.10 Compiler programming frame 266
19 Compiler – Error Messages 275
20 Assembler – Introduction 276
20.1 Setting the user travel units 276
20.1.1 Travel distance factors NUMERATOR/DENOMINATOR 276
20.1.2 UNIT 278
20.2 First steps 279
20.2.1 Starting the IPOS$^{plus®}$ Assembler 279
20.2.2 Creating a new program 280
20.2.3 Compiling and starting the program 281
21 Assembler – Editor 282
21.1 Example 283
21.2 Creating programs 283
21.2.1 Inserting command lines 283
21.3 Compiling and downloading 284
21.4 Starting/stopping programs 285
21.4.1 Variable window 285
21.5 File/unit comparison 285
21.6 Debugger 285
21.6.1 Execute to cursor 286
21.6.2 Single step 286
21.7 Loading the program from the inverter 287
21.8 Overview of the icons 287

22 Assembler – Programming 288
22.1 Basics 288
22.1.1 Program header 288
22.1.2 Task 1 / Task 2 / Task 3 288
22.1.3 Comments 288
22.1.4 Program branches 288
22.1.5 Subroutine system 288
22.1.6 Program loops 289
22.1.7 Positioning commands 289
22.1.8 Binary/analog inputs/outputs 289
22.1.9 Access to system values/parameters 289
22.1.10 Variables 290
22.1.11 Program line 290
22.2 Binary inputs/outputs 291
22.2.1 Binary inputs 291
22.2.2 Binary outputs 293
22.3 Analog inputs/outputs 296
22.3.1 Reading analog inputs/outputs 296
22.3.2 Setting analog outputs 296
23 Assembler – Commands 297
23.1 General information 297
23.2 Overview of commands 297
23.2.1 Arithmetic commands 297
23.2.2 Bit commands 298
23.2.3 Communication commands 298
23.2.4 Positioning commands 299
23.2.5 Program commands 299
23.2.6 Set commands 300
23.2.7 Special unit commands 300
23.2.8 Comparison commands 301
23.3 Arithmetic commands 302
23.3.1 Fundamental operations ADD / SUB / MUL / DIV 302
23.3.2 Auxiliary arithmetic functions NOT / MOD 303
23.3.3 Logical operations AND / OR / XOR 304
23.3.4 SHIFT commands SHL / SHR / ASHR 305
23.4 Bit commands 307
23.4.1 Bit commands BSET / BCLR / BMOV / BMOVN 307
23.5 Communication commands 309
23.5.1 MOVLNK 309
23.5.2 MOVCOM 314
23.5.3 MOVON 315
23.5.4 SCOM 316
23.5.5 SCOMON 321
23.5.6 SCOMST 322

23.6 Positioning commands ... 323
23.6.1 Reference travel GO0 ... 323
23.6.2 GOA absolute positioning / GOR relative positioning ... 325
23.7 Program commands ... 329
23.7.1 Program command END ... 329
23.7.2 Subroutine call CALL ... 329
23.7.3 Jump commands JMP ... 330
23.7.4 Loop commands LOOP ... 332
23.7.5 No Operation NOP / remark REM / return RET / TASK / TASK2 / wait WAIT ... 333
23.8 Set commands ... 336
23.8.1 Copy variables COPY ... 336
23.8.2 Read system values GETSYS ... 336
23.8.3 Set commands variable SET / fault response SETFR / Indirect addressing SETI / Interrupt SETINT / system values SETSYS ... 339
23.8.4 SETSYS ... 344
23.8.5 VARINT ... 347
23.9 Special unit commands ... 349
23.9.1 ASTOP / MEM / TOUCHP / WDOFF / WDON ... 349
23.10 Comparison commands ... 355
23.10.1 Comparison operations CPEQ / CPGE / CPGT / CPLE / CPLT / CPNE ... 355
23.10.2 Logical operations ANDL / ORL / NOTL ... 358
24 Assembler – Examples ... 360
24.1 "Flashing light" sample program ... 360
24.1.1 Sample "Controller" ... 360
24.1.2 Sample "Positioning" ... 361
24.2 "Hoist" sample program ... 362
24.2.1 Characteristics ... 362
24.2.2 Settings ... 362
24.2.3 Schematic structure ... 363
24.2.4 Terminal wiring ... 364
24.2.5 Setting parameters relevant to the example ... 365
24.2.6 Calculating the IPOS$^{plus®}$ parameters ... 365
24.2.7 Input terminals ... 366
24.2.8 Output terminals ... 366
24.2.9 Program source code (with remarks) ... 367
24.3 "Jog mode" sample program ... 368
24.3.1 Characteristics ... 368
24.3.2 Settings ... 368
24.3.3 Input terminals ... 369
24.3.4 Output terminals ... 369
24.3.5 Program source code (with remarks) ... 370

24.4 "Table positioning" sample program 372
24.4.1 Characteristics 372
24.4.2 Settings 373
24.4.3 Input terminals 374
24.4.4 Output terminals 374
24.4.5 Program source code (with remarks) 375
Index 378

1 General Information

1.1 Structure of the safety notes

The safety notes in these operating instructions are designed as follows:

Pictogram	⚠ SIGNAL WORD
	Type and source of danger. Possible consequence(s) if disregarded. • Measure(s) to prevent the danger.

Pictogram	Signal word	Meaning	Consequences if disregarded
Example: General danger Specific danger, e.g. electric shock	⚠ **DANGER**	Imminent danger	Severe or fatal injuries
	⚠ **WARNING**	Possible dangerous situation	Severe or fatal injuries
	⚠ **CAUTION**	Possible dangerous situation	Minor injuries
	NOTICE	Possible damage to property	Damage to the drive system or its environment
	INFORMATION	Useful information or tip. Simplifies the handling of the drive system.	

1.2 Liability for defects

Compliance with this manual and the operating instructions of the units is prerequisite for fault-free operation and fulfillment of any right to claim under warranty. You should therefore read the manual and operating instructions of the units before you start working with the software and units.

Make sure that the operating instructions are available to persons responsible for the machinery and its operation as well as to persons who work independently on the units. You must also ensure that the operating instructions are legible.

1.3 Exclusion of liability

You must comply with the information contained in this manual and in the operating instructions of the units to ensure safe operation and to achieve the specified product characteristics and performance requirements. SEW-EURODRIVE assumes no liability for injury to persons or damage to equipment or property resulting from non-observance of the operating instructions. In such cases, any liability for defects is excluded.

1.4 Copyright

© 2009 – SEW-EURODRIVE. All rights reserved.

Copyright law prohibits the unauthorized duplication, modification, distribution, and use of this document, in whole or in part.

2 Safety Notes

The following basic safety notes must be read carefully to prevent injury to persons and damage to property. The operator must ensure that the basic safety notes are read and observed. Ensure that persons responsible for the system and its operation as well as persons who work independently on the units have read through the manual carefully and understood it. If you are unclear about any of the information in this documentation, please contact SEW-EURODRIVE.

The following safety notes refer to the use of the IPOS$^{plus®}$ positioning and sequence control system. Also take into account the supplementary safety notes in the individual sections of this documentation and in the documentation of the units.

2.1 General information

Read through this manual carefully before you start working with IPOS$^{plus®}$.

This document does not replace the detailed operating instructions for the units. This manual assumes that the user has access to, and is familiar with, the documentation on the units.

Never install damaged products or put them into operation. Submit a complaint to the shipping company immediately in the event of damage. Only qualified personnel observing the applicable accident prevention regulations and operating instructions are allowed to perform installation and startup tasks.

During operation, units with this type of enclosure may have live, uninsulated, and sometimes moving or rotating parts as well as hot surfaces.

Removing covers without authorization, improper use, as well as incorrect installation or operation may result in severe injuries to persons or damage to machinery.

Refer to the documentation for more information.

2.2 Designated use

Use the positioning and sequence control system with IPOS$^{plus®}$ for the following units from SEW-EURODRIVE GmbH & Co KG:

- MOVIDRIVE® B
- MOVITRAC® B
- MQx

In addition, the following discontinued products support IPOS$^{plus®}$:

- MOVIDRIVE® A
- MOVIDRIVE® *compact*
- MOVITRAC® 07

2.3 Target group

The IPOS$^{plus®}$ user is a qualified person has been trained accordingly.

SEW-EURODRIVE recommends that the user attends additional product training courses for units and motors that are programmed with IPOS$^{plus®}$.

Any work related to installation, startup and maintenance of the devices as well as troubleshooting may only be performed by qualified personnel. Observe IEC 60364 and CENELEC HD 384 or DIN VDE 0100 and IEC 60664 or DIN VDE 0110 as well as the national accident prevention regulations.

Qualified personnel in the context of these basic safety notes are persons familiar with installation, assembly, startup and operation of the product who possess the required qualifications.

All work in further areas of transportation, storage, operation and waste disposal must be carried out by qualified personnel who are appropriately trained.

2.4 Programming errors

The IPOS$^{plus®}$ positioning and sequence control system allows you to adjust the IPOS$^{plus®}$ units to meet the exact specifications of your application. As with all positioning systems there is, however, the risk of a programming error, which may result in unexpected (although not uncontrolled) system behavior.

3 System Description

3.1 Introduction

The basic functions and options of IPOS$^{plus®}$ units ensure that the program is no longer only an open-loop speed controller.

In fact, the positioning and sequence control system integrated in MOVIDRIVE® can often take a great deal of the load off the machine controller (PLC), or maybe even replace it.

Reducing the central control offers SEW customers significant potential savings in terms of hardware and the complexity of electrical installation.

The programming work is divided between the PLC and inverter control. However, users must familiarize themselves with the system. This includes getting to know IPOS$^{plus®}$ if you want to make effective use its benefits.

3.1.1 Scope of this documentation

The present documentation provides information on the positioning and sequence control with IPOS$^{plus®}$ for MOVIDRIVE® B.

With a reduced command set, IPOS$^{plus®}$ can also be used in conjunction with the MOVITRAC® B control cabinet inverter and the MQx modules from decentralized technology. Any deviations regarding the functionality compared to MOVIDRIVE® B are pointed out in the respective technical data in the following sections:

- IPOS$^{plus®}$ for MOVITRAC® B see (page 118)
- IPOS$^{plus®}$ for MQx see (page 120)

First, the manual describes the language-independent functions of IPOS$^{plus®}$.

- Position control
- Position processing
- Task management
- Interrupt management
- IPOS parameters
- IPOS variables

Then, the documentation focuses on the programming in compiler language.
SEW-EURODRIVE recommends that you create new programs in Compiler language. All MOVIDRIVE® B units can be programmed in this language.

Next, the documentation focuses on the programming in assemble language.

The final section describes program examples. It includes an example for beginners with the basic structure of the state machine of a sequential program. We recommend that you begin with this basic structure and develop the user program from there.

3.1.2 Creating programs

You can create IPOS$^{plus®}$ programs using either the Assembler or the Compiler. Both programming tools are included in the MOVITOOLS® MotionStudio software package.

	INFORMATION Application modules solve typical drive tasks without the user having to create a program. Instead of programming, you only have to set the parameters for a tried and tested program (application module) created by SEW-EURODRIVE. This saves you time, and you do not need the programming know-how described in this manual.

3.2 IPOS$^{plus®}$ – features

- In conjunction with encoder feedback, IPOS$^{plus®}$ **positioning control** provides high-performance point-to-point positioning capability.
- The program is run independent of encoder feedback and operating mode.
- The unit continues to run the user program even if the unit develops a malfunction (troubleshooting is possible in the user program).
- IPOS$^{plus®}$ can run several user programs/tasks simultaneously, independent of one another. `Tasks` can be interrupted using interrupts.
- The user programs can contain several 100 program lines (see Technical data (page 25)).
- Easy-to-use and comprehensive control options for IPOS$^{plus®}$ units.
- Access to all available options:
  - Input/output card
  - Fieldbus interfaces
  - Synchronous operation card
- Extensive communication options:
  - System bus (S-bus)
  - RS-485 (RS-232 with USS21A, UWS11A, UWS21A interface adapters)
  - Fieldbus interfaces
- Processing of binary and analog input/output signals.
- Positioning with adjustable travel speed and positioning ramps.
- Presetting for position, speed and torque control loops with minimized lag error.

- Absolute encoder processing.
- 1024 32-bit variables are available in the IPOS$^{plus®}$ program (see Technical data (page 25)).
- With IPOS$^{plus®}$, all inverter parameters can be read and written via communication commands.
- 2 touch probe inputs.
- Ramp types:
  - Linear
  - Sine
  - Square
  - Bus ramp
  - Jerk-limited
  - Electronic cam
  - I-synchronous operation
- Status and monitoring functions:
  - Lag error monitoring
  - Position reporting
  - Software and hardware limit switches
  - Encoder function
- 9 reference travel types
- The following functions can be changed during movement:
  - Target position
  - Travel speed
  - Positioning ramp
  - Torque
- "Endless positioning" is possible.
- Override function.
- The following technology functions can be controlled with a virtual encoder:
  - Electronic cam
  - Internal synchronous operation

- Programming in the Compiler also offers:
  - Program creation in a high-level language
  - Symbolic variable names
  - Possibility of creating program modules that can be used again in other projects
  - Clear, modular and structured programming
  - Different programming techniques for loops
  - Compiler control using preprocessor commands
  - Standard structures
  - User-defined structures
  - Standard functions
  - Debugger for troubleshooting
  - Extensive options for making comments
- Programming in the Assembler offers:
  - Remark lines
  - Programming in user travel units (units are entered in the program header)
- Setpoint selection. Depending on the hardware and the required setpoint, the following options are available for the specification:
  - Analog setpoints
  - Fixed setpoints
  - Fixed setpoints + analog setpoints
  - Motor potentiometer
  - Master/slave operation with SBus
  - Master/slave operation with RS-485
  - DRS setpoint (only with the DRS11 option)
  - Fieldbus/fieldbus monitor setpoint (only with the fieldbus interface option)
  - IPOS$^{plus®}$ position setpoint

  Whether you need to use encoder feedback for setpoint processing depends on which operating mode is selected. The setpoint that is actually active depends on the following settings:
  - Operating mode P700
  - Setpoint source P100
  - Setting of the input terminal parameters P600 ... P619
  - Fieldbus PO data assignment/monitor mode
  - Selection of manual operation

3.3 Controlling IPOS$^{plus®}$ units

IPOS$^{plus®}$ units can be controlled as follows:

- Control via input terminals on the unit
- IPOS$^{plus®}$ control word on "System variable" H484 CTRL. WORD
- RS-485 interface
- Fieldbus interface
- SBus (system bus)

3.3.1 Active control signal source

Control via input terminals and the IPOS$^{plus®}$ control word H484 are always in effect.

You can determine additional control signal sources using the following parameters:

- Setpoint source P100
- Control signal source P101
- Process data description P870 ... P872

3.4 Technology options / application modules

3.4.1 Technology options

MOVIDRIVE® units with the technology option (ending OT in the unit designation) offer additional functions, such as:

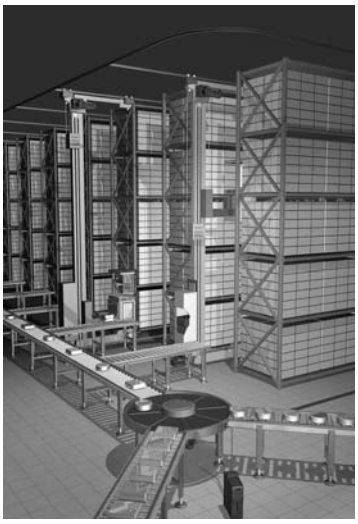
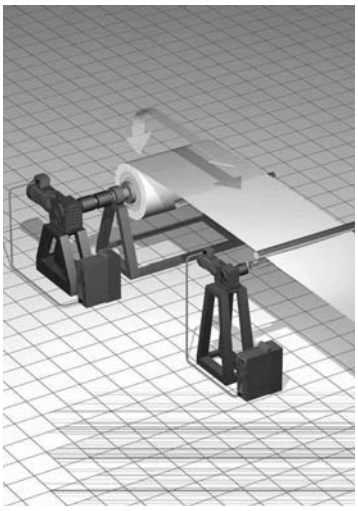
- Internal Synchronous Operation (ISYNC)
- Electronic cam
- Application modules
- Auto ASR (Anti slip regulation, currently only available with MOVIDRIVE® A)
- SBus TP (SBus touch probe, only available with MOVIDRIVE® A; in the MOVIDRIVE® B standard unit, this is solved using a variable interrupt).

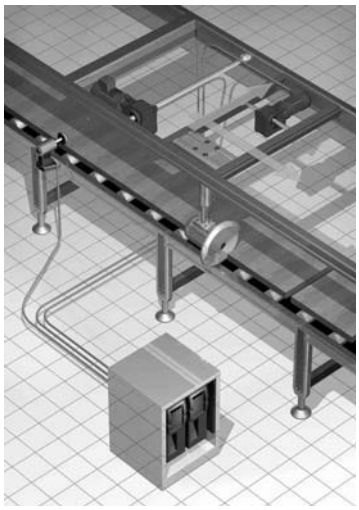
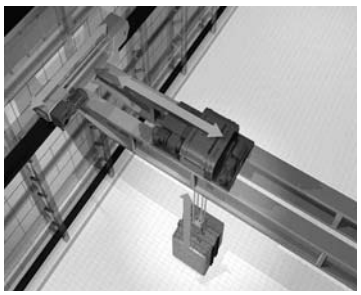
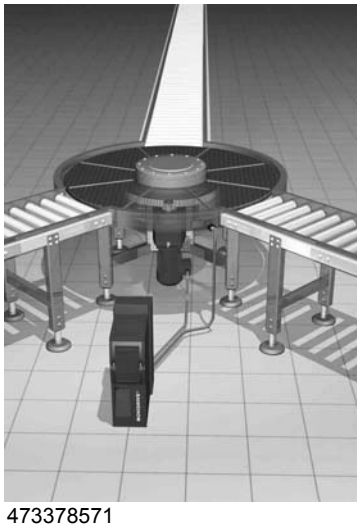
The functions "internal synchronous operation (ISYNC)" and "electronic cam" are explained in the section "IPOS$^{plus®}$ and synchronized movements" and described in detail in separate manuals. In these cases, additional IPOS$^{plus®}$ variables are assigned system functions that you can address in IPOS$^{plus®}$ user programs.

3.4.2 Application modules

An application module is a protected user program designed by SEW that can be loaded into the inverter.

A comprehensive package of coordinated functions, easy-to-use input boxes and finely-tuned user guidance make startup easier to handle. The user cannot adjust the IPOS$^{plus®}$ program.

Overview of application modules	
Positioning	 473361163
Winding	 473365515

Overview of application modules	
Flying saw	 473369867
Internal Synchronous Operation ISYNC (only MOVIDRIVE® B and MCH)	 473374219
Rotatory positioning	 473378571

The intelligent application modules in the technology option offer a new level of functionality. All the important machine data is easily accessible. There are almost no sources for errors, since only those parameters required for the application have to be entered. All relevant data, for example, terminal states or position values, can be observed using a diagnostics tool during the ongoing operating process.

The functionality of each these modules is described in individual manuals.

3.5 Technical data

3.5.1 MOVIDRIVE® B

Encoder resolution: X15, motor encoder X14, external encoder X62, absolute encoder (including absolute encoder from HIPERFACE®)	IPOS$^{plus®}$ always operates with 4096 increments/motor revolution (Pre-requisite: Encoder resolution of 128, 512, 1024 or 2048 pulses/motor revolution (any other encoder resolutions are not permitted) or resolver)
Maximum program length/program memory:	16 kByte corresponds to ca. 200 ... 250 Assembler commands
Command processing time:	the total in Task 1 und Task 2 ≤ 12 Assembler commands/ms): Task 1: 1 ... 10 Assembler commands/ms Task 2: 2 ... 11 Assembler commands/ms Task 3: free computing time
Interrupts:	1 interrupt triggered by timer, error or touch probe interrupts task 1. 4 variable interrupts that interrupt task 2 and 3.
Variables:	1024, of which 128 (0 ... 127) can be stored in non-volatile memory Value range: - 2^{31} ... +(2^{31} - 1)
System variable area	IPOS variables H453 to H560
Touch probe inputs:	2 inputs, processing time 200 µs
Sampling interval of analog inputs:	1 ms
Sampling interval of binary inputs:	1 ms
Binary inputs/outputs:	MOVIDRIVE® B: 8 inputs/6 outputs DIO option: 8 inputs/8 outputs DIP option: 8 inputs/8 outputs
Analog inputs/outputs:	MOVIDRIVE® B: 1 input (0 ... 10 V, ±10 V, 0 ... 20 mA, 4 ... 20 mA) DIO option: 1 input (0 ... 10 V, ±10 V, 0 ... 20 mA) 2 outputs (±10 V, 0 ... 20 mA, 4 ... 20 mA)

3.5.2 MOVITRAC® B

Encoder resolution:	MOVITRAC® B has no encoder inputs but supports the position detection via binary inputs (counter input). For the technical data of the binary inputs, refer to section "Position detection via binary inputs" (page 96)	
Maximum program length/program memory:	8 kByte	
Command processing time:	Task 1: 1 Assembler command/ms Task 2: 2 Assembler commands/ms	
Interrupts:	-	
Variables:	1024, of which 128 (0 ... 127) can be stored in non-volatile memory	
System variable area	IPOS variables H453 to H560	
Touch probe inputs:	-	
Sampling interval of analog inputs:	1 ms	
Sampling interval of binary inputs:	5 ms	
Binary inputs/outputs:	MOVITRAC® B FIO21B option	6 inputs/3 outputs 7 Inputs
Analog inputs/outputs:	MOVITRAC® B FIO11B option	1 input (0 ... 10 V) 1 input (± 10 V) 1 output (0 ... 20 mA, 4 ... 20 mA)

3.5.3 MQx

Encoder resolution:	MQx module has no encoder inputs but supports the position detection via binary inputs (counter input). For the technical data of the binary inputs, refer to section "Position detection via binary inputs" (page 96)
Maximum program length/program memory:	4 kByte
Command processing time:	Task 1: 1 Assembler command/ms Task 2: 2 Assembler commands/ms
Interrupts:	-
Variables:	512, of which 128 (0 ... 127) can be stored in non-volatile memory
System variable area	IPOS variables H453 to H511
Touch probe inputs:	-
Sampling interval of analog inputs:	-
Sampling interval of binary inputs:	4 ms/input frequency at the counter inputs: max. 4 KHz
Binary inputs/outputs:	MQ.21./MQ.22.: 4 inputs and 2 outputs MQ.32.: 6 Inputs
Analog inputs/outputs:	-

3.6 Reference documents

This document describes the IPOS$^{plus®}$ positioning and sequence control integrated in MOVIDRIVE®.

The following reference list is an overview of the documents referred to in this documentation. You do not have to have read these documents to be able to program with IPOS$^{plus®}$; they simply offer additional information.

All the documents are available on the SEW-EURODRIVE website under http://www.sew-eurodrive.de

3.6.1 General manuals

- MOVIDRIVE® MDX60B/61B system manual
- MOVITRAC® B system manual
- Manuals for the MQx field distributors

3.6.2 Manuals for serial interfaces/fieldbuses

- MOVIDRIVE® MDX60B/61B Communication and Fieldbus Unit Profile
- DFx MOVIDRIVE® fieldbus interface

3.6.3 Manuals for synchronized axis movements

- MOVIDRIVE® Electronic Cam, addendum to the system manual
- MOVIDRIVE® Synchronous Operation Card Type DRS11
- MOVIDRIVE® Internal Synchronous Operation

3.6.4 Manuals for application modules

- MOVIDRIVE® Positioning with Absolute Encoder Option DIP11
- MOVIDRIVE® Extended Positioning via Bus
- MOVIDRIVE® Bus Positioning
- MOVIDRIVE® Table Positioning with Bus Control
- MOVIDRIVE® Modulo Positioning

3.6.5 Manuals for the MQx fieldbus interfaces

- Drive System for Decentralized Installation: PROFIBUS Interfaces, Field Distributors
- Drive System for Decentralized Installation: INTERBUS Interfaces, Field Distributors
- Drive System for Decentralized Installation: DeviceNet/CANopen Interfaces, Field Distributors

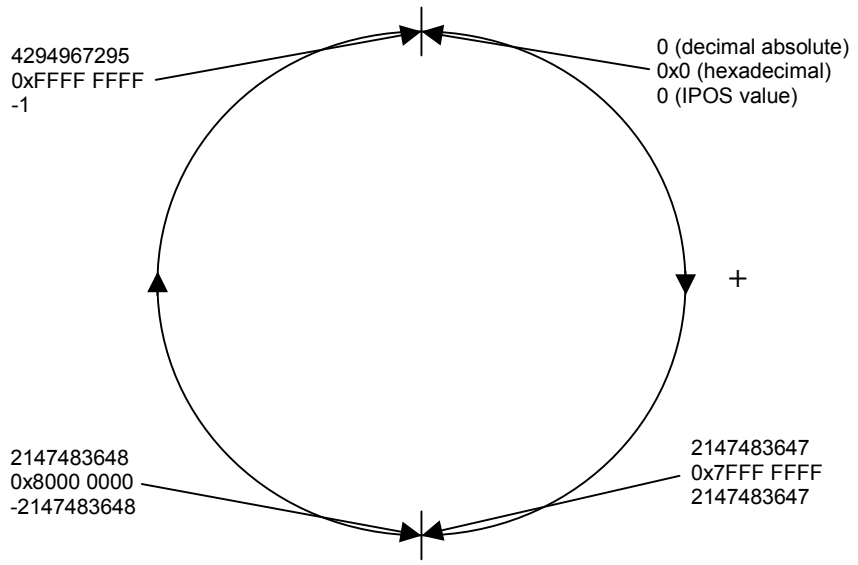
4 IPOS Variables

4.1 Introduction

The integrated positioning and sequence control system uses global variables that are used by all the tasks and interrupts. There are **no** local variables that are only declared either in a task or a function.

All variables (page 25) are 32-bit variables treated as signed integers during calculations and comparisons. In the user program, you must check that the final result of a calculation lies within the number range.

The number range can be represented as follows in a number circle:



473666955

Example:

$$H0 = 4, \quad H1 = 7, \quad H3 = \frac{H0}{H1} = 0$$

$$H0 = 2147483647, \quad H1 = 1, \quad H3 = H0 + H1 = -2147483648$$

Each variable has an index that can be used to read and write variables using, for example, the Movilink command (_MoviLink/ `MOVLNK`). The index is calculated as follows:

Index = VarNo. + 11000

Example: H371 has the index 11371.

4.2 Overview of the system variables

Some IPOS variables are assigned set functions and are referred to as system variables (page 25).

The symbolic names are available in the Compiler when one of the following lines is inserted at the start of the program:

```
#include <constb.h>   //symb. name MOVIDRIVE B system variables
```

The following table describes the function of the system variables and their names in the Compiler and Assembler.

Variables in the range specified that are not assigned are reserved for internal functions and cannot be used for user variables.

No.	Name Compiler / Assembler	Description
128		This variable can be used in a user-specific IPOS program. The variable is used by the application modules to store the program identification.
360 ... 452	Variable range for internal synchronous operation or electronic cam	This variable range is assigned additional system variables if the technology options internal synchronous operation or electronic cam are used. In all other cases, these can be used by the user as required.
453	ModuloCtrl / MODULOCTRL	Control word for the modulo function (see also modulo function and IPOS parameter). **Bit 0 TargetReset_Off** Bit 0 = 0: The current positioning task is deleted (ModTagPos is set to ModActPos) if the positioning operation is interrupted (for example, if the enable is revoked or if the controller inhibit or stop bit is set). Bit 0 = 1: The target position is held even if the enable has been revoked or if the controller inhibit or the stop bit has been set. If the drive is enabled again, it continues with the positioning process. **Bit 1 TargetGAZ_Select** Bit 1 = 0: Standard setting, 360° output corresponds to 2^{16} incr. Bit 1 = 1: Setting for increasing the resolution: 360° corresponds to the product from modulo numerator P961 x modulo encoder resolution P963. Positioning cannot be performed over several revolutions.
454	ModTagPos / MOD.TAGPOS	Modulo target position If a changed value is written to the modulo target position for an enabled inverter, positioning begins in output units. The position setpoint (for H453.1 = 0) is set in 16 bit resolution in the unit H454 MODTAGPOS = k x 360° + 0 ... 360°= k x 2^{16} + 0 ... (2^{16} -1) (k = number of complete revolutions). Once a new value has been written to the variable, only the target position within a revolution is visible in variable H454. We recommend that you also write the new value to a temporary variable for improved diagnostics. Once position 454 has been written, the firmware calculates an incremental target H492. This causes H473 bit 19 "In position" to remain set for up to 1 ms.
455	ModActPos / MOD.ACTPOS	Modulo actual position The current modulo actual position moves (in 16 bit resolution when H453.1 = 0) between 0 and 2^{16} increments (0° and 360°).
456	ModCount / MOD COUNT	Increments within a modulo revolution before scaling to the output. Display value of the internal temporary result when the incremental encoder value H509/H510/H511 (IPOS encoder value) is converted to the modulo actual position H455. For H456 = (IPOS encoder value) MOD (P961 x P963) H455 = H456/(P961 x P963) x 2^{16} (prerequisite: H453, bit 1 = 0) See section "Modulo positioning". If 0 is written to H456, H455 is set automatically to 0.

No.	Name Compiler / Assembler	Description
473	StatusWord / STAT.WORD	**The status word can be used to query the operating status of the inverter.** **Bit function with level "1"** 0 No function 1 /Malfunction 2 Ready 3 Output stage on 4 Rotating field ON 5 Brake released 6 Brake applied 7 Motor standstill (from n < 20 rpm) 8 Parameter set 9 Speed reference (P400) 10 Speed window (P410) 11 Setpoint/actual comparison (P420) 12 Current reference (P430) **Bit function with level "1"** 13 Imax signal (P442) 14 /Motor utilization 1 15 /Motor utilization 2 16 /DRS prewarning 17 /DRS lag error 18 DRS slave in position 19 IPOS in position (see also H493) 20 IPOS referenced 21 Reserved 22 /IPOS fault 23 Reserved 24 Current limit reached 25 LSM commutated 26 S-pattern profile is generated 27 Inverter in safe stop 28..31 Reserved If the actual position of the drive is within the position window around the target position, the "IPOS in position" bit is set even when the enable signal is removed or the controller inhibit is activated.
474	Scope474 / SCOPE 474	These two variables can be used together with the oscilloscope SCOPE function integrated in MOVITOOLS® MotionStudio to record measured values. Example: Measurement of the actual position value of a modulo axis. In the IPOS program, the command H474 = H455 is called up cyclically and in SCOPE, channel 1 is set to IPOS variable H474 Low and channel 2 is set to IPOS variable H474 High.
475	Scope475 / SCOPE 475	
476	DRS_Ctrl / DRS CTRL.	**Signal level of the binary outputs of the synchronous operation board DRS11, READ and SET.** **Bit terminal level** 0 X40.9 AUSG0 1 X40.10 AUSG1 2..14 Reserved 15 Set hardware fault DRS (fault 48) 16..31 Reserved
477	DRS_Status / DRS STATUS	**Signal level of the binary inputs and status signals of the synchronous operation board type DRS11, READ.** **Bit terminal level / status signals** 0 X40.5 INP4 free input 1 1 X40.6 INP5 Free input 2 2 /DRS prewarning 3 /DRS lag error 4 DRS slave in position 5 Master standstill 6..31 Reserved
478	AnaOutpIPOS2 / ANA.OUT IP2	**Analog outputs of the terminal expansion board type DIO11, only SET.** The value of variable H478 is output on an analog output when the corresponding terminal is programmed to "IPOS OUTPUT 2". Option DIO11 is required for MOVIDRIVE® A and B; for MCH and MCS / MCV / MCV 40A, an output can be programmed as a binary output or analog output. **Variable value physical outputOutput terminal assignment** - 10000..0..10000 AOV1/AOC1/AO01 P640 analog output AO1 = IPOS OUTPUT 2 - 10000..0..10000 AOV2/AOC2/AO01 P643 analog output AO2 = IPOS OUTPUT 2

<table>
<tr><th>No.</th><th>Name
Compiler /
Assembler</th><th>Description</th></tr>
<tr><td>479</td><td>AnaOutpIPOS /
ANA.OUT IP</td><td>Analog outputs of the terminal expansion board type DIO11, only SET.
The value of variable H479 is output on an analog output when the corresponding terminal is programmed to "IPOS OUTPUT".
Option DIO11 is required for MOVIDRIVE® A and B; for MCH and MCS / MCV / MCV 40A, an output can be programmed as a binary output or analog output.
Variable value physical outputOutput terminal assignment
- 10000..0..10000 AOV1/AOC1/AO01 P640 analog output AO1 = IPOS OUTPUT
- 10000..0..10000 AOV2/AOC2/AO01 P643 analog output AO2 = IPOS OUTPUT</td></tr>
<tr><td>480</td><td>OptOutpIPOS /
OPT.OUT IP</td><td>Binary outputs of the terminal expansion board types DIO11/DIP11, only SET.
The READ function can be performed for MOVIDRIVE® A using H482 and for MOVIDRIVE® B using H521.
If a DIO11 or DIP11 option is not inserter, virtual terminals can be set in status word 2 via fieldbus if, for example, P873 = STATUSWORD 2.
The bits of variable H480 are reproduced on the binary outputs of the basic unit if the relevant terminal is set to IPOS OUTPUT.
If a binary output is toggled in IPOS, the physical output at the terminal is toggled 1 ms later if it is set as the IPOS output.
<table>
<tr><th rowspan="2">Bit</th><th rowspan="2">IPOS name</th><th>DIO (+ DIO)</th><th>DIO + DIP</th><th>DIO + -field-bus</th><th>DIP</th><th>DIP + field-bus</th><th>Fieldbus</th></tr>
<tr><td colspan="3">P63x has an effect on DIO</td><td colspan="2">P63x has an effect on DIP</td><td>P873 status word 2</td></tr>
<tr><td>0</td><td>DO10</td><td>X23:1</td><td>X23:1</td><td>X23:1</td><td>X61:1</td><td>X61:1</td><td>Bit 8</td></tr>
<tr><td>1</td><td>DO11</td><td>X23:2</td><td>X23:2</td><td>X23:2</td><td>X61:2</td><td>X61:2</td><td>Bit 9</td></tr>
<tr><td>2</td><td>DO12</td><td>X23:3</td><td>X23:3</td><td>X23:3</td><td>X61:3</td><td>X61:3</td><td>Bit 10</td></tr>
<tr><td>3</td><td>DO13</td><td>X23:4</td><td>X23:4</td><td>X23:4</td><td>X61:4</td><td>X61:4</td><td>Bit 11</td></tr>
<tr><td>4</td><td>DO14</td><td>X23:5</td><td>X23:5</td><td>X23:5</td><td>X61:5</td><td>X61:5</td><td>Bit 12</td></tr>
<tr><td>5</td><td>DO15</td><td>X23:6</td><td>X23:6</td><td>X23:6</td><td>X61:6</td><td>X61:6</td><td>Bit 13</td></tr>
<tr><td>6</td><td>DO16</td><td>X23:7</td><td>X23:7</td><td>X23:7</td><td>X61:7</td><td>X61:7</td><td>Bit 14</td></tr>
<tr><td>7</td><td>DO17</td><td>X23:8</td><td>X23:8</td><td>X23:8</td><td>X61:8</td><td>X61:8</td><td>Bit 15</td></tr>
<tr><td>8</td><td></td><td></td><td>X61:1</td><td></td><td></td><td></td><td></td></tr>
<tr><td>9</td><td></td><td>(X23:1)</td><td>X61:2</td><td></td><td></td><td></td><td></td></tr>
<tr><td>10</td><td></td><td>...</td><td>X61:3</td><td></td><td></td><td></td><td></td></tr>
<tr><td>11</td><td></td><td>(X23:8)</td><td>X61:4</td><td></td><td></td><td></td><td></td></tr>
<tr><td>12</td><td></td><td></td><td>X61:5</td><td></td><td></td><td></td><td></td></tr>
<tr><td>13</td><td></td><td></td><td>X61:6</td><td></td><td></td><td></td><td></td></tr>
<tr><td>14</td><td></td><td></td><td>X61:7</td><td></td><td></td><td></td><td></td></tr>
<tr><td>15</td><td></td><td></td><td>X61:8</td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>481</td><td>StdOutpIPOS /
STD.OUT IP</td><td>Binary outputs of the basic unit, only SET.
If a binary output is toggled in IPOS, the physical output at the terminal is toggled 1 ms later if it is set as the IPOS output.
<table>
<tr><th>Bit</th><th>IPOS name</th><th></th></tr>
<tr><td>0</td><td>DB00</td><td>cannot be programmed, fixed assignment with "/Brake"</td></tr>
<tr><td>(0)</td><td>DO00 MQx</td><td>If P628 = IPOS OUTPUT (only MQx)</td></tr>
<tr><td>1</td><td>DO01</td><td>If P620 = IPOS OUTPUT</td></tr>
<tr><td>2</td><td>DO02</td><td>If P621 = IPOS OUTPUT</td></tr>
<tr><td>3</td><td>DO03</td><td>Only with MOVIDRIVE® B if P622 = IPOS OUTPUT</td></tr>
<tr><td>4</td><td>DO04</td><td>Only with MOVIDRIVE® B if P623 = IPOS OUTPUT</td></tr>
<tr><td>5</td><td>DO05</td><td>Only with MOVIDRIVE® B if P624 = IPOS OUTPUT</td></tr>
</table></td></tr>
</table>

No.	Name Compiler / Assembler	Description							
482	OutputLevel / OUTPUT LVL MOVIDRIVE® A (MOVIDRIVE® B: H521)	**Signal level of the binary outputs, READ only.**							
		Bit	**IPOS name**	**DIO (+ DIO)**	**DIO + DIP**	**DIO + -field-bus**	**DIP**	**DIP + field-bus**	**Fieldbus**
				P63x has an effect on DIO			P63x has an effect on DIP		P873 status word 2
		0	DB00	DB00	DB00	DB00	DB00	DB00	DB00
		1	DO01	DO01	DO01	DO01	DO01	DO01	DO01
		2	DO02	DO02	DO02	DO02	DO02	DO02	DO02
		3	DO10	X23:1	X23:1	X23:1	X61:1	X61:1	Bit 8
		4	DO11	X23:2	X23:2	X23:2	X61:2	X61:2	Bit 9
		5	DO12	X23:3	X23:3	X23:3	X61:3	X61:3	Bit 10
		6	DO13	X23:4	X23:4	X23:4	X61:4	X61:4	Bit 11
		7	DO14	X23:5	X23:5	X23:5	X61:5	X61:5	Bit 12
		8	DO15	X23:6	X23:6	X23:6	X61:6	X61:6	Bit 13
		9	DO16	X23:7	X23:7	X23:7	X61:7	X61:7	Bit 14
		10	DO17	X23:8	X23:8	X23:8	X61:8	X61:8	Bit 15
		11			X61:1				
		12		(X23:1)	X61:2				
		13		...	X61:3				
		14		(X23:8)	X61:4				
		15			X61:5				
		16			X61:6				
					X61:7				
					X61:8				
483	InputLevel / INPUT LVL MOVIDRIVE® A (MOVIDRIVE® B: H520)	**Signal level of the binary inputs, READ only.**							
		Bit	**IPOS name**	**DIO (+ DIO)**	**DIO + DIP**	**DIO + -field-bus**	**DIP**	**DIP + field-bus**	**Fieldbus** P870 = status word 2
		0	DI00	Depends on the basic unit, e.g. X13:1					
		1	DI01	X13:2					
		2	DI02	X13:3					
		3	DI03	X13:4					
		4	DI04	X13:5					
		5	DI05	X13:6					
		6	DI10	X22:1	X22:1	X22:1	X60:1	X60:1	Bit 8
		7	DI11	X22:2	X22:2	X22:2	X60:2	X60:2	Bit 9
		8	DI12	X22:3	X22:3	X22:3	X60:3	X60:3	Bit 10
		9	DI13	X22:4	X22:4	X22:4	X60:4	X60:4	Bit 11
		10	DI14	X22:5	X22:5	X22:5	X60:5	X60:5	Bit 12
		11	DI15	X22:6	X22:6	X22:6	X60:6	X60:6	Bit 13
		12	DI16	X22:7	X22:7	X22:7	X60:7	X60:7	Bit 14
		13	DI17	X22:8	X22:8	X22:8	X60:8	X60:8	Bit 15
		14			X60:1				
		15		(X22:1)	X60:2				
		16		...	X60:3				
		17		(X22:8)	X60:4				
		18			X60:5				
		19			X60:6				
		20			X60:7				
		21			X60:8				

No.	Name Compiler / Assembler	Description	
484	ControlWord / CTRL.WORD	**IPOS$^{plus®}$ control word (unit functions READ and SET).** The IPOS$^{plus®}$ control word can always be used, irrespective of the operating mode, control signal source and setpoint source. The IPOS$^{plus®}$ control word is connected by an OR command with the terminal functions, the fieldbus control word and the control word in the unit via the RS-485/RS-232 and the SBus.	
		Bit function with level "1" 0 No function 1 No enable 2 CW 3 CCW 4 n11/n21 (fixed setpoint 1) 5 n12/n22 (fixed setpoint 2) 6 Fixed setpoint selection 7 Parameter switchover (param. set 2) 8 Ramp switchover (ramp set 2) 9 Motor potentiometer up 10 Motor potentiometer down 11 External fault 12 Fault reset 13 Hold control 14 CW limit switch 15 CCW limit switch	**Bit function with level "1"** 16 Reserved 17 Reference cam 18 Reference travel start 19 Slave free running 20 Setpoint block 21 Reserved 22 DRS zero point set 23 DRS slave start 24 DRS teach in 25 Reserved 26 Reserved 27 Condition Monitoring switching signal: Drive vibration warning 28 Condition Monitoring switching signal: Vibration fault 29 Condition Monitoring switching signal: Brake wear error 30 Controller inhibit 31 Reserved
485	T0_Reload / T0 RELOAD	READ and SET loading value for the user timer 0 cycle time. The cycle time can be specified with H485 if a user timer (TIMER0 (H489)) is to be used cyclically with the SET INTERRUPT (SETINT) command. The time value entered in H485 is reloaded automatically with this time value every time the timer 0 runs down (H489 = 0). Value range: 0 ... 2^{31} -1 ms.	
486	Reserved		
487	Timer_2 / TIMER 2	**Time for user timer 2, READ and SET.** User time 2 counts upwards. Value range: 0 ... 2^{31} -1 ms.	
488	Timer_1 / TIMER 1	**Time for user timer 1, READ and SET.** User timer 1 counts downwards to 0. Value range: 0 ... 2^{31} -1 ms.	
489	Timer_0 / TIMER 0	**Time for user timer 0, READ and SET.** User timer 0 counts downwards to 0. An interrupt branch is performed when the timer value reaches 0 if the SET INTERRUPT (SETINT) command is being used. The cycle time can be specified with the variable T0 RELOAD (H485) if a user timer is to be used cyclically with the SET INTERRUPT (SETINT) command. See section "Task management and interrupts". Value range: 0 ... 2^{31} -1 ms.	

No.	Name Compiler / Assembler	Description
490	WdogTimer / WD.TIMER	**Time for the user watchdog, READ and SET.** The watchdog timer counts down to 0. The WATCHDOG ON (WDON) command activates the timer and determines the cycle time. Value range: 0 ... 2^{31} -1 ms.
491	SetpointPos / SETP.POS.	**Current setpoint position, READ.** **IMPORTANT: System control variable Value must not be overwritten.** The setpoint position always has the following unit, regardless of the encoder pulse count per revolution: 4096 Inc./motor revolution (encoder resolution ≥ 512). The current setpoint position represents the **absolute** position that is **currently** valid for position control in the travel job in progress. The changes of the setpoint position result from the calculated travel profile taking into account the positioning ramp, the travel speed, the ramp type etc. Once the requested travel has been completed and the drive is in standstill, H491 corresponds to H492. Value range: -2^{31} ... 0 ... 2^{31} -1 inc.
492	TargetPos / TARGET POS	**Current target position, READ and SET.** The target position always has the following unit, regardless of the encoder pulse count per revolution: 4096 Inc./motor revolution (encoder resolution ≥ 512). This variable represents the current target position of the travel job currently in progress. H492 displays the position in its absolute form. Example: 1. current drive position: 50000 Inc. 2. GOR NOWAIT #-8000 Inc. 3. current target position: 42000 Inc. Value range: -2^{31} ... 0 ... 2^{31} -1 inc. If H492 is written directly (not using a GO command), H473, bit 19 "In position" remains set for up to 1 ms.
493	PosWindow / POS.WINDOW	**Positioning window, READ and SET.** H493 is identical to P922. The positioning window defines a distance range around the target position (H492) of a travel or stop command (GOx or ASTOP TARGET POSITION). As soon as the drive has reached the positioning window, the signal "IPOS IN POSITION" is generated. This message is available via a binary output that is to be parameterized to the "IPOS IN POSITION" function and in the system variable H473, bit 19. The "IPOS IN POSITION" message is reset as soon as a GO command is placed. The position window is always monitored provided an operating mode with IPOS is active (P700). The positioning accuracy is not affected by the value of the position window. Setting range: 0 ... **50** ... 2^{15} - 1 increments
494	LagWindow / LAG WINDOW	**Lag error window, READ and SET.** H494 is identical to P923. The lag error window defines the maximum permitted difference between the current setpoint position, which the ramp generator specifies every 1 ms, and the actual position. If the specified value is exceeded, fault F42 (lag error) is triggered. The response to F42 must be set using parameter P834 "Response LAG ERROR". **Deactivation**: You can deactivate the lag error monitoring by setting the P923 Lag error window to 0. Setting range: 0 ... **5000** ... 2^{31} - 1 increments
495	LagDistance / LAG DISTAN	**Lag distance, READ.** Value of the current lag distance in positioning (difference between setpoint and actual position). Value range: 0 ... 2^{31} - 1 increments
496	SLS_right / SLS RIGHT	**Software limit switch CW, READ and SET.** H496 is identical to P920. Limits travel in a clockwise direction. The value is given in user travel units. Setting range: - 2^{31} ... **0 user units** ... 2^{31} - 1 increments
497	SLS_left / SLS LEFT	**Software limit switch CCW, READ and SET.** H497 is identical to P921. Limits travel in a counterclockwise direction. The value is given in user travel units. Setting range: - 2^{31} ... **0 user units** ... 2^{31} - 1 increments
498	RefOffset / REF.OFFSET	**Reference offset, READ and SET.** H498 is identical to P900. The reference object allows for a shift of the machine zero without physically shifting the reference mark. The following applies: **Machine zero = reference position + reference offset** The drive moves to the reference point during the reference travel and stops there. After the reference travel, the machine zero is calculated with reference point and reference offset. The reference offset is given in user travel units. Setting range: - 2^{31} ... **0** ... + 2^{31} - 1

<table>
<tr><th>No.</th><th>Name
Compiler /
Assembler</th><th>Description</th></tr>
<tr><td>499</td><td>SetpPosBus /
SP.POS.BUS</td><td>Setpoint position bus, READ.
Contains the setpoint position which is sent via the fieldbus process data. The setpoint position is only accepted if "POSITION LO" and "POSITION HI" are programmed in the PO-data description (parameter group P87_).</td></tr>
<tr><td>500</td><td>TpPos2_VE /
TP.POS2VE</td><td>Only used in MOVIDRIVE® B; reserved in MOVIDRIVE® A.
The value of the virtual encoder H376 is stored in H599 if input DI03 has been activated (see also _TouchProbe()/TOUCHP).</td></tr>
<tr><td>501</td><td>TpPos1_VE /
TP.POS1VE</td><td>Only used in MOVIDRIVE® B; reserved in MOVIDRIVE® A.
The value of the virtual encoder H376 is stored in H501 if input DI02 has been activated (see also _TouchProbe()/TOUCHP).</td></tr>
<tr><td>502</td><td>TpPos2_Abs /
TP.POS2ABS</td><td rowspan="7">The touch probe positions are stored in the following variables:

Encoder | Encoder position | Touch probe 1 DI02 | Touch probe 2 DI03
Motor encoder (X15) | H511 ACTPOS.MOT | H507 TP.POS1MOT | H505 TP.POS2MOT
External encoder (X14) | H510 ACTPOS.EXT | H506 TP.POS1EXT | H504 TP.POS2EXT
Absolute encoder (X62) | H509 ACTPOS.ABS | H503 TP.POS1ABS | H502 TP.POS2ABS</td></tr>
<tr><td>503</td><td>TpPos1_Abs /
TP.POS1ABS</td></tr>
<tr><td>504</td><td>TpPos2_Ext /
TP.POS2EXT</td></tr>
<tr><td>505</td><td>TpPos2_Mot /
TP.POS2MOT</td></tr>
<tr><td>506</td><td>TpPos1_Ext /
TP.POS1EXT</td></tr>
<tr><td>507</td><td>TpPos1_Mot /
TP.POS1MOT</td></tr>
<tr><td>508</td><td>IPOS counter</td><td>• Counter value for the frequency input (if it is activated via DIP switch S14)
• High-resolution motor position (if the interpolated position signal is set via P916)</td></tr>
<tr><td>509</td><td>ActPos_Abs /
ACTPOS ABS</td><td>Current actual position of the DIP absolute encoder (SSI), READ.
IMPORTANT: System control variable Value must not be overwritten.
This actual position is determined via the signals which are active on plug connector X62 (DIP11A option).
Unit: Increments depending on the encoder resolution.</td></tr>
<tr><td>510</td><td>ActPos_Ext /
ACTPOS EXT</td><td>READ current actual position external encoder.
IMPORTANT: System control variable Value must not be overwritten.
The actual position is determined via the track signals which are active on plug connector X14. Position detection is only performed if connector X14 is used as the encoder input.
Unit: Increments depending on the encoder resolution.</td></tr>
<tr><td>511</td><td>ActPos_Mot /
ACTPOS.MOT</td><td>READ current actual position motor encoder.
IMPORTANT: System control variable Value must not be overwritten.
The actual position always has the following unit, regardless of the encoder pulse count per revolution: 4096 increments per motor revolution (encoder resolution 512 inc., exception: MQx with NV26 has 24 Increments per motor revolution).</td></tr>
</table>

Furthermore, the following variables are assigned functions or reserved in MOVIDRIVE B®:

<table>
<tr><th>No.</th><th>Name
Compiler /
Assembler</th><th>Description</th></tr>
<tr><td>512
...
515</td><td>Reserved</td><td></td></tr>
<tr><td>516</td><td>CCount_MotOn</td><td>Activate C track (zero pulse) counter for motor encoder X15.
0 = Counter disabled/1 = Counter enabled</td></tr>
<tr><td>517</td><td>CCount_ExtOn</td><td>Activate C track (zero pulse) counter for external encoder X14.
0 = Counter disabled/1 = Counter enabled</td></tr>
<tr><td>518</td><td>CCount_Mot</td><td>Counting of the zero pulses at X15. Low word is incremented with every zero pulse at the motor encoder X15.</td></tr>
<tr><td>519</td><td>CCount_Ext</td><td>Counting of the zero pulses at X14. Low word is incremented with every zero pulse at the external encoder X14.</td></tr>
<tr><td>520</td><td>InpLevelB /
INPUTLVLB
MOVIDRIVE® B
(MOVIDRIVE® A:
H483)</td><td>Signal level of the binary inputs, READ only.
<table>
<tr><th>Bit</th><th>IPOS name</th><th>DIO (+ DIO)</th><th>DIO + DIP</th><th>DIO + fieldbus</th><th>DIP</th><th>DIP + fieldbus</th><th>Fieldbus
P870 = control word 2</th></tr>
<tr><td>0</td><td>DI00</td><td colspan="6">Depends on the basic unit, e.g. X13:1</td></tr>
<tr><td>1</td><td>DI01</td><td colspan="6">X13:2</td></tr>
<tr><td>2</td><td>DI02</td><td colspan="6">X13:3</td></tr>
<tr><td>3</td><td>DI03</td><td colspan="6">X13:4</td></tr>
<tr><td>4</td><td>DI04</td><td colspan="6">X13:5</td></tr>
<tr><td>5</td><td>DI05</td><td colspan="6">X13:6</td></tr>
<tr><td>6</td><td>DI06</td><td colspan="6">X16:1</td></tr>
<tr><td>7</td><td>DI07</td><td colspan="6">X16:2</td></tr>
<tr><td>8</td><td>DI10</td><td>X22:1</td><td>X22:1</td><td>X22:1</td><td>X60:1</td><td>X60:1</td><td>Bit 8</td></tr>
<tr><td>9</td><td>DI11</td><td>X22:2</td><td>X22:2</td><td>X22:2</td><td>X60:2</td><td>X60:2</td><td>Bit 9</td></tr>
<tr><td>10</td><td>DI12</td><td>X22:3</td><td>X22:3</td><td>X22:3</td><td>X60:3</td><td>X60:3</td><td>Bit 10</td></tr>
<tr><td>11</td><td>DI13</td><td>X22:4</td><td>X22:4</td><td>X22:4</td><td>X60:4</td><td>X60:4</td><td>Bit 11</td></tr>
<tr><td>12</td><td>DI14</td><td>X22:5</td><td>X22:5</td><td>X22:5</td><td>X60:5</td><td>X60:5</td><td>Bit 12</td></tr>
<tr><td>13</td><td>DI15</td><td>X22:6</td><td>X22:6</td><td>X22:6</td><td>X60:6</td><td>X60:6</td><td>Bit 13</td></tr>
<tr><td>14</td><td>DI16</td><td>X22:7</td><td>X22:7</td><td>X22:7</td><td>X60:7</td><td>X60:7</td><td>Bit 14</td></tr>
<tr><td>15</td><td>DI17</td><td>X22:8</td><td>X22:8</td><td>X22:8</td><td>X60:8</td><td>X60:8</td><td>Bit 15</td></tr>
<tr><td>16</td><td></td><td></td><td>X60:1</td><td></td><td></td><td></td><td></td></tr>
<tr><td>17</td><td></td><td>(X22:1)</td><td>X60:2</td><td></td><td></td><td></td><td></td></tr>
<tr><td>18</td><td></td><td>...</td><td>X60:3</td><td></td><td></td><td></td><td></td></tr>
<tr><td>19</td><td></td><td>(X22:8)</td><td>X60:4</td><td></td><td></td><td></td><td></td></tr>
<tr><td>20</td><td></td><td></td><td>X60:5</td><td></td><td></td><td></td><td></td></tr>
<tr><td>21</td><td></td><td></td><td>X60:6</td><td></td><td></td><td></td><td></td></tr>
<tr><td>22</td><td></td><td></td><td>X60:7</td><td></td><td></td><td></td><td></td></tr>
<tr><td>23</td><td></td><td></td><td>X60:8</td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
</table>

<table>
<tr><th>No.</th><th>Name
Compiler /
Assembler</th><th>Description</th></tr>
<tr><td>521</td><td>OutpLevelB /
OUTPUTLVLB
MOVIDRIVE® B
(MOVIDRIVE® A:
H482)</td><td>Signal level of the binary outputs, READ only.
<table>
<tr><th>Bit</th><th>IPOS name</th><th>DIO (+ DIO)</th><th>DIO + DIP</th><th>DIO + - fieldbus</th><th>DIP</th><th>DIP + fieldbus</th><th>Fieldbus
P873 = status word 2</th></tr>
<tr><td>0</td><td>DB00</td><td>DB00</td><td>DB00</td><td>DB00</td><td>DB00</td><td>DB00</td><td>DB00</td></tr>
<tr><td>1</td><td>DO01</td><td>DO01</td><td>DO01</td><td>DO01</td><td>DO01</td><td>DO01</td><td>DO01</td></tr>
<tr><td>2</td><td>DO02</td><td>DO02</td><td>DO02</td><td>DO02</td><td>DO02</td><td>DO02</td><td>DO02</td></tr>
<tr><td>3</td><td>DO03</td><td>DO03</td><td>DO03</td><td>DO03</td><td>DO03</td><td>DO03</td><td>DO03</td></tr>
<tr><td>4</td><td>DO04</td><td>DO04</td><td>DO04</td><td>DO04</td><td>DO04</td><td>DO04</td><td>DO04</td></tr>
<tr><td>5</td><td>DO05</td><td>DO05</td><td>DO05</td><td>DO05</td><td>DO05</td><td>DO05</td><td>DO05</td></tr>
<tr><td>6</td><td>DO10</td><td>X23:1</td><td>X23:1</td><td>X23:1</td><td>X61:1</td><td>X61:1</td><td>Bit 8</td></tr>
<tr><td>7</td><td>DO11</td><td>X23:2</td><td>X23:2</td><td>X23:2</td><td>X61:2</td><td>X61:2</td><td>Bit 9</td></tr>
<tr><td>8</td><td>DO12</td><td>X23:3</td><td>X23:3</td><td>X23:3</td><td>X61:3</td><td>X61:3</td><td>Bit 10</td></tr>
<tr><td>9</td><td>DO13</td><td>X23:4</td><td>X23:4</td><td>X23:4</td><td>X61:4</td><td>X61:4</td><td>Bit 11</td></tr>
<tr><td>10</td><td>DO14</td><td>X23:5</td><td>X23:5</td><td>X23:5</td><td>X61:5</td><td>X61:5</td><td>Bit 12</td></tr>
<tr><td>11</td><td>DO15</td><td>X23:6</td><td>X23:6</td><td>X23:6</td><td>X61:6</td><td>X61:6</td><td>Bit 13</td></tr>
<tr><td>12</td><td>DO16</td><td>X23:7</td><td>X23:7</td><td>X23:7</td><td>X61:7</td><td>X61:7</td><td>Bit 14</td></tr>
<tr><td>13</td><td>DO17</td><td>X23:8</td><td>X23:8</td><td>X23:8</td><td>X61:8</td><td>X61:8</td><td>Bit 15</td></tr>
<tr><td>14</td><td></td><td></td><td>X61:1</td><td></td><td></td><td></td><td></td></tr>
<tr><td>15</td><td></td><td>(X23:1)</td><td>X61:2</td><td></td><td></td><td></td><td></td></tr>
<tr><td>16</td><td></td><td>...</td><td>X61:3</td><td></td><td></td><td></td><td></td></tr>
<tr><td>17</td><td></td><td>(X23:8)</td><td>X61:4</td><td></td><td></td><td></td><td></td></tr>
<tr><td>18</td><td></td><td></td><td>X61:5</td><td></td><td></td><td></td><td></td></tr>
<tr><td>19</td><td></td><td></td><td>X61:6</td><td></td><td></td><td></td><td></td></tr>
<tr><td>20</td><td></td><td></td><td>X61:7</td><td></td><td></td><td></td><td></td></tr>
<tr><td>21</td><td></td><td></td><td>X61:8</td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>522</td><td>RecStatS1 /
SBUS1REC</td><td>Status word for receiving SCOM data objects (double words) via the system bus
A receive bit is reserved for each data object set up using _SBusCommDef/SCOM. The first receive object initialized in the IPOS program is assigned bit 0, the second one bit 1, etc. When MOVIDRIVE® receives a telegram from an initialized receive object, the corresponding bit is set. The bit can only be reset in the user program. Event-driven telegrams can be sent and received via the SBus if a variable interrupt has been set for the corresponding bit in H522. The bit reset must make up the last command in the interrupt routine. When designing a process image, the user must ensure that no side effects are caused when the same object is received during processing (cyclical receipt of an object). To reset the bit, use the BITCLEAR command so that receive bits in other transfers are not lost.</td></tr>
<tr><td>523</td><td>RecStatS2 /
SBUS2REC</td><td>Only with CAN bus via DFC11B: Status word for receiving SCOM data objects (double words) via the CAN bus
A receive bit is reserved for each data object set up using _SBusCommDef/SCOM. The first receive object initialized in the IPOS program is assigned bit 0, the second one bit 1, etc. When MOVIDRIVE® receives a telegram from an initialized receive object, the corresponding bit is set. The bit can only be reset in the user program. Event-driven telegrams can be sent and received via the SBUS if a variable interrupt has been set for the corresponding bit in H523. The bit reset must make up the last command in the interrupt routine. When designing a process image, the user must ensure that no side effects are caused when the same object is received during processing (cyclical receipt of an object). To reset the bit, use the BITCLEAR command so that receive bits in other transfers are not lost.</td></tr>
</table>

No.	Name Compiler / Assembler	Description
524	IPOS_Setp / IPOS_SETP	**IPOS setpoint, correcting variable of the PID controller when H540 = 1.** When H540 = 0 or 2 the setpoint can also be written directly from the user program. H524 can be used as a torque setpoint or speed setpoint when P100 Setpoint source = IPOS and P700 Operating mode 1 = xxx&M-control, CFC or SERVO. 1 increment in H524 then corresponds to 0.21 rpm setpoint speed or 0.01% I_N torque setpoint
525 ... 529	Reserved	
530	VarIntReq / VARINTREQ	If the corresponding request bit of a variable interrupt is set, a variable interrupt is triggered irrespective of the actual interrupt condition. The relevant variable interrupt must be activated beforehand. Bit 0: Request for variable interrupt 0 Bit 1: Request for variable interrupt 1 Bit 2: Request for variable interrupt 2 Bit 3: Request for variable interrupt 3
540	PID_Mode / PID.MODE	Operating mode of the PID controller, H540 and P260 are identical. 0 = Controller deactivated (default) 1 = Control active 2 = Step response (open control system)
541	PID_K_p / PID.KP	PID-controller: Factor of the proportional component, H541 and P263 are identical, 3 decimal places; 0 <= K_P <= 32000 (= 32,000); default: 1000 (= 1,0)
542	PID_Outp_P / PID.OUTPP	PID-controller: Current value of the controller's P-component
543	PID_Outp_I / PID.OUTPI	PID-controller: Current value of the controller's I-component The value for the I-component is in the high word, the internal components for decimal places are in the low word, for example, H543 = 0x30000 -> I-component = 3.
544	PID_Outp_D / PID.OUTPD	PID-controller: Current value of the controller's D-component
545	PID_Feedf / PID.FEEDF	PID controller precontrol value; H545 and P266 are identical -32000 <= Precontrol <= 32000; default: 0
546	PID_Command / PIDCOMMAND	PID-controller: Setpoint, H546 and P271 are identical When P270 = 0 (= "Parameter"), P271/H546 contains the required process setpoint -32000 <= Setpoint <= 32000 (for speed control, 1 increment corresponds to 0.2/min); default: 0
547	PID_CmdAdr / PID.CMDADR	PID-controller: Setpoint address, H547 and P272 are identical When P270 = 1 (= "IPOS variable"), P272/H547 contains the address of the IPOS variable with the setpoint; default: 0
548	PID_CmdScale / PID.CMDSCA	PID controller: Factor for scaling the setpoint, H548 and P274 are identical, weighted with 3 decimal places -32000 (-32,000) <= $K_{Setpoint}$ <= 32000 (32,000); default: 1000 (1,0)
549	PID_ActAdr / PID.ACTADR	PID controller: Address of actual value, H549 and P276 are identical When P275 = "IPOS variable", P276/H549 contains the address of the IPOS variable; default: 0
550	PID_ActScale / PID.ACTSCA	PID-controller. Scaling factor of the filtered actual value, H550 and P277 are weighted identically with 3 decimal places -32,000 <= $K_{Actual\ value}$ <= 32,000; default: 1000 (1,0)
551	PID_ActNorm / PID.ACTNOR	PID controller: Filtered and scaled actual value, diagnostics value
552	PID_ActOffset / PID.ACTOFF	PID controller: Integer, permanent offset of actual value, H552 and P278 are identical -32000 (-32000) <= Offset <= 32000 (32000); default: 0
553	PID_ActMin / PID.ACTMIN	PID controller: Minimum value for actual value after smoothing, scaling and offset, H553 and P280 are identical. -32000 (-32000) <= $x_{e,min}$ <= 32000 (32000); Default: 0
554	PID_ActMax / PID.ACTMAX	PID controller: Maximum value for actual value after smoothing, scaling and offset, H554 and P281 are identical. -32000 (-32000) <= $x_{e,max}$ <= 32000 (32000); default: 10000 (10,0)
555	PID_LimitMin / PID.LMTMIN	PID controller: Minimum output value, H555 and P282 are identical -32000 (-32000) <= $x_{controller,min}$ <= 32000 (32000); default: -1000 (-1,0)
556	PID_Limit_Max / PID.LMTMAX	PID controller: Maximum output value, H556 und P283 are identical -32000 (-32000) <= $x_{controller,max}$ <= 32000 (32000); default: 10000 (1,0)

No.	Name Compiler / Assembler	Description
557	PID_SetpMin / PID.SETMIN	PID controller: Minimum output value for correcting variable, H557 and P284 are identical -32000 (-32000) <= $x_{a,min}$ <= 32000 (32000); Default: 0
558	PID_SetpMax / PID.SETMAX	PID controller: Maximum output value for correcting variable, H558 and P285 are identical -32000 (-32000) <= $x_{a,max}$ <= 32000 (32000); Default: 7500 (7,5)
559	PID_Status / PID.STATUS	PID-controller status word Bit 0 = Total of actual value and offset exceeds limit xe_{min} Bit 1 = Total of actual value and offset exceeds limit xe_{max} Bit 2 = Value of the controller P-component is limited Bit 3 = I-component of the controller is deactivated Bit 4 = Value of the controller I-component is limited Bit 5 = Value of the controller D-component is limited Bit 6 = PID-controller correcting variable is limited Bit 7 = Total of PID-controller correcting variable and presetting is limited
560	Reserved	

5 Task Management and Interrupts

5.1 Introduction

IPOS$^{plus®}$ can process several subprograms at the same time. One subprogram corresponds to one task. The following functions can trigger interrupts for task 1:

- Timer0 overflow
- System error/unit error
- Touch probe DI02

MOVIDRIVE® B can interrupt task 2 and task 3 with 4 additional interrupts, which are triggered by the comparison with a variable value.

MOVIDRIVE® A can execute 2 subprograms – task1 and task 2 – running independently of each other.

MOVIDRIVE® B can execute 3 subprograms – task1, task 2 and task 3 – running independently of one another.

You can run MOVIDRIVE® B in the same way as MOVIDRIVE® A.

The following variables are global. All tasks and interrupts use the same variables:

- H0 - H511 for MOVIDRIVE® A
- H0 - H1023 for MOVIDRIVE® B

There are no local variables that are only declared in either a task or a function. There is an overview of the areas reserved for system variables in section "IPOS variables / Overview of the System Variables".

You can enter the commands in a program window. You must create all program sections using the same language: Assembler or Compiler.

5.2 Task management for MOVIDRIVE® A and B

Task 1 is the main program. You can start task 1 using the lightning symbol in the toolbar or using the keypad (P931). Initialize and start task 2 and task 3 using program commands. Task 3 is only available with MOVIDRIVE® B. The interrupt is initialized using program commands and triggered using an interrupt event. If you stop task 1 using the STOP icon in the toolbar, this stops the entire IPOS processing. The DBG keypad can be used to stop all tasks by setting parameter P931 to STOP. When P931 = STOP, only task 1 is stopped. After a restart the program continues where it was interrupted.

Toolbar for MOVIDRIVE® A

473926155

[1] = Status of task 1: START = started
[2] = Status of task 2: PSTOP = stopped
[3] = Lightning icon to start task 1
[4] = STOP icon to stop the entire IPOS processing

Toolbar for MOVIDRIVE® B

474186507

[1] = Status of task 1: PSTOP = stopped
[2] = Status of task 2: PSTOP = stopped
[3] = Status of task 3: PSTOP = stopped
[4] = Lightning icon to start task 1
[5] = STOP icon to stop the entire IPOS processing

IPOS$^{plus®}$ processes a task cyclically. A task starts with the first command again once the last command has been completed. If you only want to execute an initialization routine in task 1 once, you can exclude this program section using an endless loop.

```
main()
{
   // Program code only initialization
 while(1)
 {
     // cyclical program code
 }
}
```

The following table gives an overview of the functions and properties of the tasks and interrupts.

	Task 1	**Task 2**	**Task 3 (only MOVIDRIVE® B)**	**"Task1" interrupt**	**Variable interrupt (only MOVIDRIVE® B)**
Start MOVIDRIVE® A	Lightning icon or P931 in keypad	_SetTask2(ST2_START, Task2Name); or TASK2 START Mxx	Not available	With the defined interrupt event	Not available
Start MOVIDRIVE® B		_SetTask(ST2_START, Task2Name); or TASK TASK2, START Mxx	_SetTask(ST3_START, Task3Name); or TASK TASK3, START Mxx		With the defined interrupt event
Stop MOVIDRIVE® A	STOP icon or P931 in keypad	STOP icon or _SetTask2(ST2_STOP, Task2Name); or TASK2 STOP Mxx	Not available	As task 1	Not available
Stop MOVIDRIVE® B		STOP icon or _SetTask(ST2_STOP, Task2Name); or TASK TASK2, STOP Mxx	STOP icon or _SetTask(ST3_STOP, Task3Name); or TASK TASK3, STOP Mxx		As task 1 or as assigned task 2 or 3
Interrupt MOVIDRIVE® A	Via "Task1" interrupt	Cannot be interrupted	Not available	With other task 1 interrupt with higher priority	Not available
Interrupt MOVIDRIVE® B	Via "Task1" interrupt	With variable interrupt	With variable interrupt	With other task 1 interrupt with higher priority	With variable interrupt in the same task with higher priority
Debug with breakpoint and single step	Yes	No[1)]	No[1)]	Yes	No[1)]
Command processing time MOVIDRIVE® A	1 Assembler command/ms	2 Assembler commands/ms	Not available	Assembler command/ms	Not available
Command processing time MOVIDRIVE® B	1 ... 10 Assembler commands/ms, factory setting: 1 command/ms	2 ... 11 Assembler commands/ms, factory setting: 2 commands/ms	min. 1 command per ms; additional commands are processed depending on the processor utilization	As task 1	As task to which the interrupt is assigned (task 2 or 3)

1) Copy commands to task 1 for debugging.

5.3 Tasks for MOVIDRIVE® A

In addition to the general section in chapter "Task Management for MOVIDRIVE® A and B", this section provides specific implementation information for MOVIDRIVE® A: The motion sequence with the positioning commands is programmed in task 1.

Program the following functions in task 2:

- Rapid, time-critical processes
- Calculations
- Monitoring for system values
- Communication with the SEW operator terminals
- Copying variables cyclically to the oscilloscope variables H474, H475
- Formatting the fieldbus/SBus process data with a machine control function or another MOVIDRIVE®

In this way, IPOS$^{plus®}$ also performs these functions when the interrupt routine is active in task 1.

5.4 Tasks for MOVIDRIVE® B

In addition to the general section in chapter "Task Management for MOVIDRIVE® A and B", this section provides specific implementation information for MOVIDRIVE® B:

5.4.1 Processing time for task 1 / task 2

The factory setting for the task processing time is:

- Task 1: 1 command/ms (P938 = 0)
- Task 2: 2 commands/ms

You can speed up the processing time in both tasks to include up to 9 additional commands per ms. You can assign the additional commands for task 1 using parameter P938 (index 8888) and for task 2 using parameter P939 (index 8962). This means that a maximum of 1 + 9 = 10 commands can be performed in task 1 and 2 + 9 = 11 in task 2.

When you assign the maximum number of additional commands/ms to task 1 and task 2, the following combinations are possible:

Task 1		Task 2	
P938	Command/ms	P939	Command/ms
0	1	9	11
1	2	8	10
2	3	7	9
3	4	6	8
4	5	5	7
5	6	4	6
6	7	3	5
7	8	2	4
8	9	1	3
9	10	0	2

Example: P938 = 2, P939 = 3 => Task 1 processes 3 commands/ms, task 2 processes 5 commands/ms

5.4.2 Task 3

Task 3 is available from the B series units. Task 3 processes at least 1 command/ms. Depending on the unit configuration and on the setting of P938/P939, task 3 will perform additional commands. 20 ... 40 commands/ms is the typical number of commands for task 3. The absolute resource requirements for command processing is ca. 20 ... 40% lower in task 3 compared with task 1 or task 2. Application components, for which the guaranteed run time of the individual program lines is not important, are processed faster in task 3.

5.4.3 Implementation information

In contrast to MOVIDRIVE® A, you program the motion sequence in task 1 or task 3.

Program the following functions in task 2 or task 3:

- Rapid, time-critical processes
- Calculations
- Monitoring for system values
- Communication with the SEW operator terminals
- Copying variables cyclically to the oscilloscope variables H474, H475
- Formatting the fieldbus/SBus process data with a machine control function or another MOVIDRIVE®

In this way, IPOS$^{plus®}$ also performs these functions when the interrupt routine is active in task 1.

Note that in contrast to task 3, the processing time per command in task 2 is deterministic.

5.4.4 Example

MOVIDRIVE® B positions a travel drive. A PLC controls MOVIDRIVE® via a fieldbus. Change the individual parameters directly on MOVIDRIVE® using SEW keypads.

Proposed solution:

Task 1: Programming the motion sequence

Task 2: HMI communication with the operator terminal

Task 3: Fieldbus communication with the PLC

It is important to distribute the additional commands correctly, depending on the application:

- **Interrupt-oriented programs:**When a user program is interrupt-oriented and the task 1 interrupts should be processed quickly, task 1 must be assigned a high calculation priority using additional commands in P938.
- **Runtime-optimized programs:**If, for example, process data is to be converted in IPOS, this must be done as quickly as possible. Task 3 can be used to process convert routines as quickly as possible. In this case, task 1 and task 2 should be assigned as few additional commands/ms as possible. This ensures the fastest total application performance if tasks 1 and 2 run with the minimum speed.

5.5 Interrupts

An interrupt - triggered by an event - interrupts the processing of the task it is assigned to. The entire interrupt routine is run through once, as long as it is not interrupted by an interrupt with a higher priority of the same task.

An interrupt that is activated by _SetInterrupt() or SETINT can be triggered by a timer0 overflow, a system/unit fault or touch probe DI02 and interrupts task 1.

In MOVIDRIVE® B, up to 4 additional variable interrupts can be activated using _SetVarInterrupt() or VARINT. They interrupt task 2 or task 3 as required.

The response time for task 1 interrupts (unit fault, DI02 touch probe or T0_overflow) is dependent on the number of activated interrupts (1 interrupt <= 1ms, 2 interrupts <= 2ms, 3 interrupts <= 3ms). The response time for variable interrupts is dependent on the number of activated interrupts <= 1ms.

If an interrupt is triggered during a wait command, the waiting time of the command continues to run in the background. Once the program has jumped back to the task, it only has to wait the remaining time before continuing.

5.5.1 Example

A WAIT 1000 ms command in task 1 is interrupted after 500 ms. If the processing of task 1 is resumed after 175 ms, the remaining runtime is 325 ms.

5.6 Interrupts for MOVIDRIVE® A and B

The following interrupts can be used in MOVIDRIVE® A units:

- Timer0 overflow (H489) interrupt — Priority = 1 (lowest priority)
- Touch probe DI02 interrupt — Priority = 2
- Error interrupt — Priority = 3 (highest priority)

Task 1 is interrupted each time. In theory, a timer0, a touch probe and an error interrupt can be active at the same time. An interrupt assigned a higher priority can interrupt the processing of another interrupt. The DISABLE argument deactivates all interrupts. (see _SetInterrupt or SETINT)

5.6.1 Interrupt activation

Compiler: `_SetInterrupt(event ,myfunction );`

Activates an interrupt. When the `event` event occurs, the function `myfunction` is performed instead of task 1.

Assembler: `SETINT event, Mxx`

Activates an interrupt. When the `event` event occurs, the commands from label Mxx are performed instead of task 1.

5.6.2 Error interrupt

The entire interrupt routine is run through once if an error occurs. After one run-through, an Assembler command from task 1 is processed before the system checks whether the error still occurs. If the error is still present, the interrupt routine is processed again. To remain in the interrupt routine until the error is no longer present, the routine must contain a loop that fulfills this condition.

Depending on the fault response set in parameter group 83x or using the command _FaultReaction or SETFR, the program acts as follows:

- No interrupt is triggered for a specific fault if the fault response of this fault is set to NO RESPONSE.
- If the fault response of a fault xy is set to "... and warning", task 1 is continued from the same place once the fault has been reset.
- If the fault response of a fault xy is set to "... and fault", IPOS is restarted once the fault has been reset and the variables are reinitialized with the values from the EEPROM. Note: In this case, you can store important variable values protected against power failure with the MEM or MOVILINK command before resetting the error. In doing so, note that the number of permissible write accesses must not be exceeded (see MEM or _Memorize()).

Sample

```
fnErrorInterrupt()
{
 H2++;
 while( !(StatusWord & 0b10))
 {
  //only leave while-loop when drive is fault-free
    H1++;
 }
}

main()
{
   _SetInterrupt(SI_ERROR, fnErrorInterrupt);
 while(1)
 {
  H0++;
 }
}
```

H0 is incremented as long as the inverter is functioning correctly. If a fault occurs, H2 is increased by one and H1 is incremented until the inverter functions correctly. Depending on the fault response set, the system either continues processing with the current values in task 1, or IPOS is restarted using the values from the EEPROM.

5.6.3 Touch probe DI02 interrupt

The entire interrupt routine is run through once if the touch probe has been released with the command _TouchProbe (condition) or TOUCHP and the edge condition is fulfilled. Then processing for task 1 continues. The interrupt routine is only called a second time when the touch probe is released again and the condition is fulfilled. (See also the command _TouchProbe or TOUCHP).

Sample

```
fnTouchInterrupt()
{
H0++;
}
/*============================================
Main function (IPOS initial function)
============================================*/
main()
{
 _SetInterrupt( SI_TOUCHP1,fnTouchInterrupt); //Act. interrupt routine
   TouchProbe( TP_EN1 );
   while (1) {H1 = H1 +1;}
}
```

H0 is increased by 1 once.

If the touch probe command is also called in the while loop or in the fnTouchInterrupt, the interrupt would respond to all changes in edge signal on DI02.

Typical applications for the touch probe are: Relative positioning for de-stacking equipment or register loop control for processes with a continuous material flow.

5.6.4 Timer0 interrupt

The entire interrupt routine is run through once when the timer has elapsed (=0). After one run-through, an Assembler command from task 1 is processed before the system checks whether the time = 0. Once the condition is fulfilled, processing branches back to the interrupt routine.

The cycle time can be set in variable H485 T0_Reload to trigger a timer0 interrupt at equal intervals. This cycle time is used to reload the timer0 automatically when it occurs in the interrupt routine

	INFORMATION Since the timer0 counts backwards, the interrupt condition would be fulfilled permanently if T0_Reload = 0 and the value of the timer has not been changed in the interrupt routine.

This results in the following options:

- If a program section is to be processed at equal intervals with the timer0 interrupt, the timer0 must be reloaded with the T0_Reload, for example.
- If a program section is to be run through once with the timer0 interrupt at a defined time after IPOS has been started, the timer0 must be set to -1 in the interrupt.

Sample

```
fnTimerInterrupt()
{
 H0 = H0 +1;
 T0_Reload = 10000; //Reload timer 0 automatically with 10 s
 _SetInterrupt( SI_TIMER0,fnTimerInterrupt);  // Activate interrupt
}
main()
{
   while (1) {H1 = H1 +1;}
}
```

H0 is increased by 1 every 10 s.

5.7 Variable interrupts with MOVIDRIVE® B

All interrupts in MOVIDRIVE® B units are the same as those used in MOVIDRIVE® A (see section "Task Management for MOVIDRIVE® A and B"), plus 4 additional variable interrupts.

The interrupts for specific variable values can, for example, respond to

- A quantity value
- All timers 0, 1 and 2
- The fact that an axis position of its own a or different axis has been reached
- A change in an I/O signal
- A certain inverter status (H473)
- New data that is to be received or sent by the SBus

5.7.1 Calling up the variable interrupt

Compiler: _SetVarInterrupt(pData ,myfunction);

Activates a variable interrupt with the data structure as of the variable pData, which runs the myfunction function, when the interrupt event occurs.

Assembler: VARINT Hxx, Mxx

Activates a variable interrupt with the data structure as of variable Hxx, which performs the commands as of the Mxx label, when the interrupt event occurs.

The following properties and functions of the variable interrupt can be defined in the data structure (see also the command _SetVarInterrupt or VARINT):

- The task to be interrupted - task 2 or task 3
- Sequential number of the interrupt (0... 3)
- Reference variable and the value to be compared with each other
- Type of the mathematical comparison (==, <, edge...)
- Processing time: either as long as the condition is fulfilled or once each time the condition is fulfilled (edge-triggered)
- Priority of the interrupt
- Value of the reference variable used to trigger the interrupt

	INFORMATION The data structure of the command is described in the system function (Compiler – functions / Assembler – commands).

The behavior of the interrupt can by adapted dynamically during runtime, by either

- Changing the data structure and then calling the command again (necessary if, for example, the CompVar value used for the comparison changes) or
- calling the command with a different data structure but with the same value in variable H+1 (IntNum).

5.7.2 IPOS access to the internal interrupt control

Information as to whether a variable interrupt has been requested can be seen in the IPOS$^{plus®}$ program in the variable uVarEventRequest (H530 bit 0 to 3). These "Request" bits can also be written in the IPOS$^{plus®}$ program.

uVarEventRequest H530.0	Request for variable interrupt 0
uVarEventRequest H530.1	Request for variable interrupt 1
uVarEventRequest H530.2	Request for variable interrupt 2
uVarEventRequest H530.3	Request for variable interrupt 3

In this way, for example, the request bit can be set for test purposes during initial startup up regardless of the actual interrupt condition and a variable interrupt can be triggered (as long as the corresponding variable interrupt has been activated beforehand).

A variable interrupt can be used to configure time-controlled program processing, for example, the cyclical calculation of acceleration from a speed.

In addition, when a high-priority variable interrupt is being processing, you can delete a pending, lower-priority interrupt by deleting the corresponding request bit.

Sample

The transport axis of a filling machine should head for a metering unit using DO01 when it moves past the position 5° on the machine. The output should be deactivated 200 ms later irrespective of the speed and axis position.

Example solved in the Compiler

Required parameter settings

P620 = IPOS output, P960 = for example SHORT

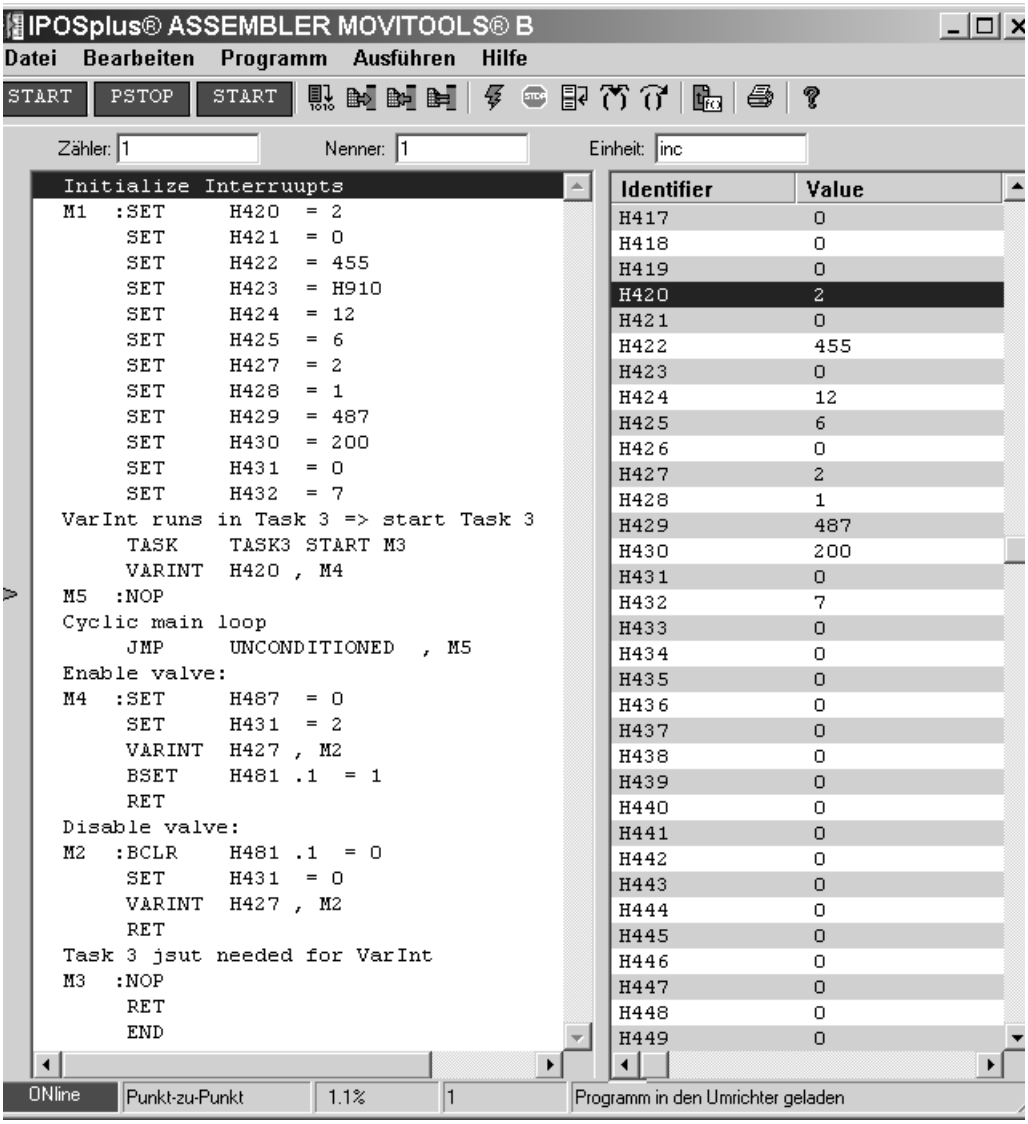
```
/*==========================================
IPOS source file
==========================================*/
#include <constb.h>
#include <iob.h>

// necessary parameter settings:
// P620 = IPOS output, P960 = for example SHORT

VARINT hOPENvalve, hCLOSEvalve;

fnTask3()
{ //Task 3 is only needed to activate VarInt.
   H1 = H1;
   //dummy command
}

fnOPENvalve()
{ //Switch on metering unit
   Timer_2 = 0;
   //Reset timer 2 to 0
   hCLOSEvalve.Mode = 2;
   //Activate stop-IRQ
   _SetVarInterrupt( hCLOSEvalve,fnCLOSEvalve );
       _BitSet( StdOutpIPOS, 1 );
   //Set DO01

}
fnCLOSEvalve()
{ //Switch off metering unit
       _BitClear( StdOutpIPOS, 1 );
   //Delete DO01
   hCLOSEvalve.Mode = 0;
   //Deactivate stop-IRQ
   _SetVarInterrupt( hCLOSEvalve,fnCLOSEvalve );
}

/*==========================================
Main function (IPOS initial function)
==========================================*/
main()
{ //Initialization part
   hOPENvalve.Control = 2;        //Interrupt task3
   hOPENvalve.IntNum =0;
   //continuous no.
 hOPENvalve.SrcVar = numof ( ModActPos );   //Modulo motor encoder
   hOPENvalve.CompVar = 910;

   // 5° on the machine = 5° x 910/65536
   hOPENvalve.Mode = 12;          // once when >= 5°
   hOPENvalve.Priority = 6;       // middle priority

   hCLOSEvalve.Control = 2;
   //Interrupt task3
   hCLOSEvalve.IntNum = 1; //continuous no.
   hCLOSEvalve.pSrcVar = numof ( Timer_2 ) ;    //Timer 2
   hCLOSEvalve.CompVar = 200;  //deactivate after 200 ms
   hCLOSEvalve.Mode = 0;            //Deactivate timer-IR first
   hCLOSEvalve.Priority = 7;
```

```
// Activate interrupt routine and task3
  _SetTask(ST3_START, fnTask3);
  _SetVarInterrupt( hOPENvalve,fnOPENvalve );
/*-------------------------------------
Main program loop
-------------------------------------*/
while(1)
  { //cyclical program section ...
    } //End while (1)
 } //End main()
```

Example solved in the Assembler

Necessary parameter settings:

P620 = IPOS output, P960 = for example SHORT



474256139

6 Position Detection and Positioning

6.1 Encoder evaluation

MOVIDRIVE® offers various options for positioning:

- external encoders
- Motor encoder (incremental encoder/resolver)
- Hiperface® encoder (absolute encoder)
- SSI absolute encoder

The values are provided in system variables for processing.

The connections for the motor encoder (X15) and external encoder (X14) are in the control electronics Mx**V**..., Mx**S**... und MC**H**... . The control electronics Mx**F** does not have these connections. The connection for the SSI absolute encoder is on the DIP11 option card (X62).

All connected encoders are always evaluated regardless of the operating mode (P700). Operating modes with positioning (VFC-n-CTRL & IPOS, CFC & IPOS, SERVO & IPOS) always require a motor encoder at X15.

Encoder type		**Absolute encoder on DIP11 P941: Absolute encoder (DIP)**	**Hiperface® encoder / incremental encoder simulation / incremental encoder P941: External encoder (X14)**	**Incremental encoder / Resolver / Hiperface® encoder P941: Motor encoder (X15)**
Connection		X62/DIP11	X14/basic unit	X15/basic unit
Actual value on variable		H509 / ACTPOS. ABS / ActPos_Abs	H510 / ACTPOS. EXT / ActPos_Ext	H511 / ACTPOS. MOT / ActPos_Mot
Resolution		Absolute position **after** conversion with: Encoder scaling (P955), Zero offset (P954), Position offset (P953), Counting direction (P951).	**Actual** encoder resolution (with 4-fold evaluation) **after** conversion with: Encoder scaling ext. encoder (P944)	**Always** 4096 inc./motor revolution, regardless of the actual encoder resolution
Touch probe	**Edge at DI02**	H503 / TP. POS1ABS / TpPos1_Abs	H506 / TP. POS1EXT / TpPos1_Ext	H507 / TP. POS1MOT / TpPos1_Mot
	Edge at DI03	H502 / TP. POS2ABS / TpPos2_Abs	H504 / TP. POS2EXT / TpPos2_Ext	H505 / TP. POS2MOT / TpPos2_Mot
	Max. delay time	1 ms	< 100 µs	< 100 µs

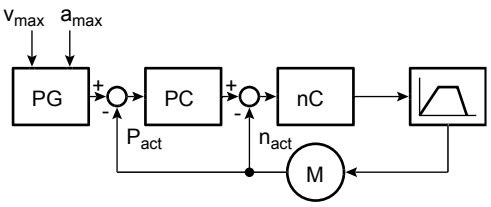
The position values are always available for IPOS$^{plus®}$ control in the variables H509 to H511. Even if positioning was performed without IPOS$^{plus®}$, impulse encoders connected to X14 and X15 can be recorded and further processed in the IPOS$^{plus®}$ program. The system variables H570 ... H573 can be used to activate zero pulse counters for motor encoder X15 and external encoder X14 in order to record the number of zero pulses. A motor encoder must be used for positioning with the IPOS$^{plus®}$ commands (GO...). The motor encoder supplies MOVIDRIVE® with a high-quality speed signal.

6.2 Motor encoder (X15)

You can only use the IPOS$^{plus®}$ positioning control when a motor encoder is connected to X15 and an operating mode ".. & IPOS" is set in P700 Operating mode 1. P941 Source actual position determines which position measurement is used for positioning. The travel commands of IPOS$^{plus®}$ control (GO commands) refer to the position information of the encoder entered in P941 Source actual position.

6.3 Encoder combinations

Direct position control with motor encoder

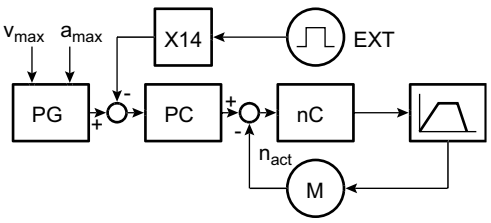


474539019

- An incremental encoder / resolver / Hiperface® encoder (X15) must be installed on the motor.
- In IPOS$^{plus®}$, positioning commands, for example, "GOA ..." are performed with reference to the actual source position (here, motor encoder X15).

v_{max} = maximum speed
a_{max} = maximum acceleration
PG = Profile generator
P_{act} = Actual position of the motor encoder
PC = Position controller
n_{act} = Actual speed
nC = Speed controller

Direct speed control with external encoder and motor encoder

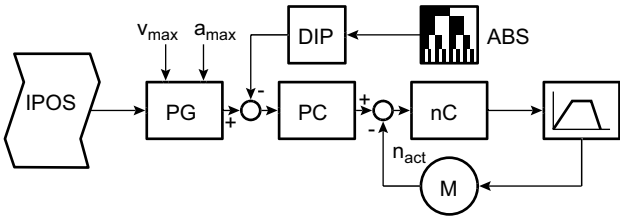


474540555

- An incremental encoder / resolver / Hiperface® encoder (X15) is always required on the motor for speed feedback.
- Slip or mechanical play (gear unit backlash) between the motor encoder and the external encoder is compensated automatically.
- In IPOS$^{plus®}$, positioning commands, for example, "GOA ..." are performed with reference to P941 actual source position (here, external encoder X14).
- The dynamic response that can be achieved depends on the properties and the mechanical installation of the external encoder as well as the position resolution.
- see section "IPOS$^{plus®}$ with Options" / "External encoder"

v_{max} = maximum speed
a_{max} = maximum acceleration
PG = Profile generator
PC = Position controller
n_{act} = Actual speed
nC = Speed controller
EXT = external encoder

Direct position control with absolute encoder and motor encoder

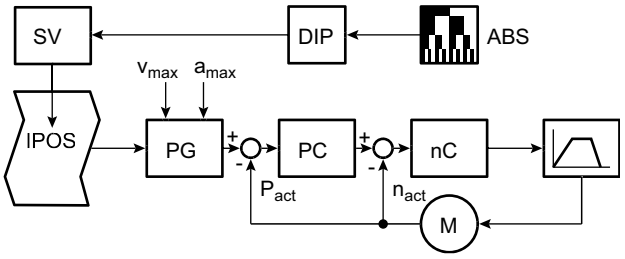


474542091

- Direct position control in IPOS$^{plus®}$ by means of the SSI absolute encoder connected via DIP11.
- An incremental encoder / resolver / Hiperface® (X15) is always required on the motor for speed feedback.
- Slip or mechanical play (gear unit backlash) between the incremental encoder /resolver / Hiperface® of the motor and the absolute encoder is compensated automatically.
- In IPOS$^{plus®}$, positioning commands, for example, "GOA ..." are performed with reference to the actual source position (here, absolute encoder DIP).
- The dynamic response that can be achieved depends on the properties and the installation of the absolute encoder as well as the position resolution.
- refer to the manual "Positioning with Absolute Encoder DIP11A"

v_{max} = maximum speed
a_{max} = maximum acceleration
PG = Profile generator
PC = Position controller
n_{act} = Actual speed
nC = Speed controller
ABS = absolute encoder
IPOS = IPOS$^{plus®}$ program

Position control with incremental encoder on the motor, Processing the absolute encoder position in the IPOS$^{plus®}$ program

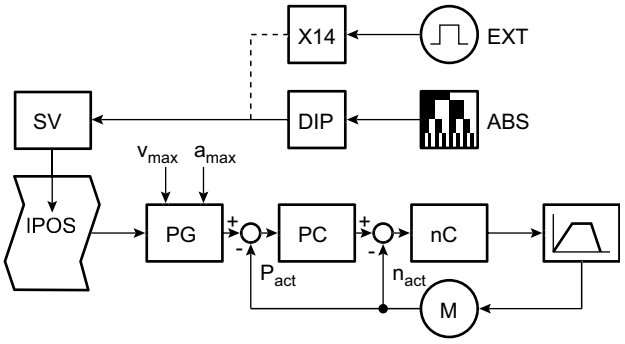


474543627

- Position control is performed in IPOS$^{plus®}$ using the motor encoder connected to X15.
- An incremental encoder / resolver is always required on the motor for speed feedback.
- The high dynamic response of the inverter can be used directly for positioning.
- The position information of the absolute encoder is mapped automatically in an IPOS$^{plus®}$ variable and can be processed using program control.
- Using the DIP11 in this way means that reference travel is unnecessary.
- refer to the manual "Positioning with Absolute Encoder DIP11"

v_{max} = maximum speed
a_{max} = maximum acceleration
PG = Profile generator
P_{act} = Actual position of the motor encoder
PC = Position controller
n_{act} = Actual speed
nC = Speed controller
ABS = absolute encoder
SV = System variable
IPOS = IPOS$^{plus®}$ program

Position control with motor encoder,
Processing the second encoder in the IPOS$^{plus®}$ program as master encoder

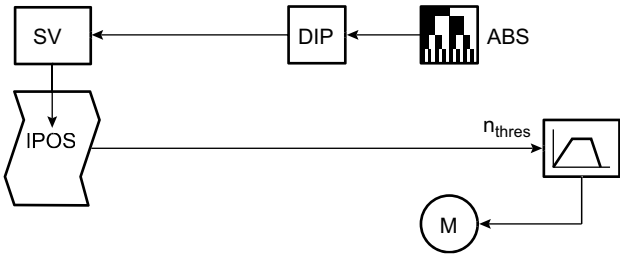


474583563

- Position control is performed in IPOS$^{plus®}$ using the motor encoder connected to X15.
- An encoder is always required on the motor for speed feedback.
- The high dynamic response of the inverter can be used directly for positioning.
- The position information of the second encoder is mapped automatically in an IPOS$^{plus®}$ variable and can be processed using program control.
- This design is used when the inverter runs in relation to a second encoder (for example, synchronous angel or electronic cam)

v_{max} = maximum speed
a_{max} = maximum acceleration
PG = Profile generator
P_{act} = Actual position of the motor encoder
PC = Position controller
n_{act} = Actual speed
nC = Speed controller
ABS = absolute encoder
EXT = external encoder
SV = System variable
IPOS = IPOS$^{plus®}$ program

Processing the absolute encoder position in the IPOS$^{plus®}$ program



474585099

- The position information of the absolute encoder is mapped automatically in an IPOS$^{plus®}$ variable and can be processed using program control.
- The DIP11 or a HIPERFACE® encoder on X14 can be used in particular to replace applications in which positioning usually takes place using rapid speed/creep speed by means of several proximity switches.
- An incremental encoder^/resolver on the motor for speed feedback is not required, you can use a standard asynchronous motor. The operating mode "... & IPOS" is not required.
- Refer to the manual "Positioning with Absolute Encoder DIP11" The application module "Absolute positioning" is available in SHELL to perform this type of positioning task.

ABS = absolute encoder
SV = System variable
IPOS = IPOS$^{plus®}$ program
n_{thres} = Setpoint speed

6.4 External encoder (X14)

The following encoders can be connected to the MOVIDRIVE®A and B drive inverters on X14. To find out which encoder type your unit supports, refer to the system manual or the operating instructions.

- Hiperface® encoder type AS1H, ES1H or AV1H (only MOVIDRIVE® B or MCH)
- sin/cos encoder type ES1S, ES2S or EV1S (only MOVIDRIVE® B or MCH)
- 5 V TTL sensor with DC 24 V voltage supply type ES1R, ES2R or EV1R
- 5 V TTL sensor with DC 5 V voltage supply type ES1T, ES2T or EV1T via option DWI11

6.4.1 Positioning on external encoder (X14)

It makes sense to use an external encoder for positioning to compensate any connection subject to slip or play between the drive and distance (for example, due to slipping wheels or tooth backlash) or any mechanical play in gear unit backlash.

Table 1: Evaluation of the pulses of the external encoder

Incoming pulses (example)	2048	2048	1024	1024
Quadruple evaluation (fixed)	8192	8192	4096	4096
Scaling external encoder P944 (can be set)	x 1	x 8	x 1	x 2
Changing counter reading H510 ACTPOS. EXT per encoder revolution	**8192**	**65536**	**4096**	**8192**

Once the control voltage has been switched on, if an AS1H or AV1H is used the absolute value of this encoder is used as the actual position value of the external encoder H510. For all other encoder types, H510 = 0 increments. The external encoder can be referenced as the motor encoder (see the chapter "Reference Travel").

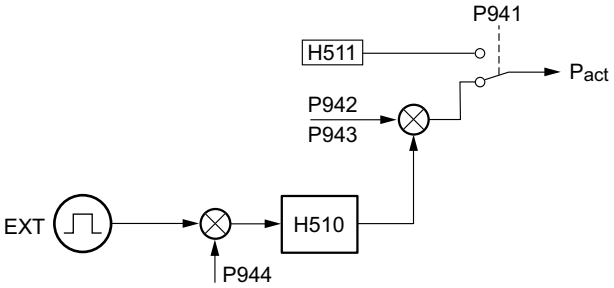
6.4.2 Slip compensation with external encoder

A trolley on wheels is run on rails. The carriage is moved by powering the wheels with a gearmotor. The connection between the wheels and the rails is non-positive. This causes slip between the rotational movement of the wheel and the resulting translational movement of the carriage.

This means, for positioning using motor control it is essential that the position of the carriage is detected.

To do so, at startup the ratio of the increments of the motor encoder must be set to the increments of the synchronous encoder. A description of these parameters with examples, and the procedure for setting them can be found in the descriptions of parameters P944, P943 and P942 in the section "IPOS Parameters."

The following block circuit diagram applies:



476710667

P_x = Non-linearized position value of encoder
P_{act} = Actual position value for ramp generator and position controller
P941 = Actual position source
P942 = Encoder factor numerator
P943 = Encoder factor denominator
P944 = Encoder scaling external encoder
H510 = External encoder with actual value on variable
H511 = Motor encoder with actual value on variable

Set the following parameters for the external encoder:

Table 2: Parameter settings for the trolley

Number	Designation	Function	Setting	Range
P944	Encoder scaling ext. encoder	Multiplies the encoder signals with the set value	Highest value that is smaller than the ratio between the resolution of the motor encoder and the external encoder. Example: Motor encoder: 4096 Inc. / ext. encoder 800 inc. = 5.12. Value: 4.	Fixed: 1, 2, 4, 8, 16, 32, 64
P943	Encoder factor denominator	Denominator to determine the ratio between the motor encoder and the ext. encoder.	Number of increments (in H511, to read ACTPOS. MOT) for a certain distance s.	max. 32767
P942	Encoder factor numerator	Numerator to determine the ratio between the motor encoder and the ext. encoder.	Number of increments (in H510, to read the ACTPOS. EXT) for a certain distance s, as for P943.	max. 32767
P941	Source actual position	Actual position value for IPOS$^{plus®}$ position controller	Ext. encoder X14	(Selection)
P945	Synchronous encoder type (X14)	Selects encoder type	Depends on the encoder that is connected.	TTL SIN/COS HIPERFACE
P946	Synchronous encoder counting direction (X14)	Inversion of the direction of rotation of the encoder	Set so that the counting direction of the motor encoder = counting direction of the external encoder.	NORMAL INVERTED

	INFORMATION The calculation of P210 (P gain hold controller) is optimized for P941 = motor encoder at start up. If you use an external encoder or absolute encoder, the parameter may have to be set to a lower value.

The following applies for position detection with an external encoder on X14:

- Variable H510 shows the actual position of the position control ACTPOS. EXT
- Variable H506 shows the touch probe position 1 TP. POS1EXT
- Variable H504 shows the touch probe position 2 TP. POS2EXT

The variables are always evaluated with parameter P944.

6.5 SSI absolute encoder (DIP)

6.5.1 Startup

The drive must be started up in conjunction with the MOVIDRIVE® drive inverter as described in the MOVIDRIVE® system manual. It must be possible to move the drive using a suitable setpoint and control signal source.

Furthermore, you must ensure that the following installations are correct and used as specified:

- Installation of the DIP11A DIP11B
- Cabling
- Terminal assignment
- Safety cut-outs

Refer to the "MOVIDRIVE ® MDX 61B DIP11B/DEH21B absolute encoder cards" manual

There is no need to activate the factory settings. If you call up a factory setting, the MOVIDRIVE® parameters will be reset to the default values. This also affects the terminal assignment, which must be altered to the required settings if necessary.

	INFORMATION MOVITOOLS® MotionStudio guides you through the startup procedure for the absolute encoder option. Various dialog boxes prompt you to make the necessary entries and take the required actions. • Start MOVITOOLS® MotionStudio and mark the unit. • Open the context menu and select the command [Startup]/[DIP startup]. • Follow the instructions of the startup wizard. Once startup with MOVITOOLS® MotionStudio has been completed, you only have to specify the *"Actual position source"* parameter.

After the DIP startup, the motor encoder and the DIP encoder are referenced during the reference travel irrespective of the setting of parameter *"Actual position source" P941*.

If the DIP encoder has been set manually, the reference travel only references the motor encoder, also irrespective of the setting of P941

Alternatively, you can perform startup for the DIP11 option for the absolute encoder step-by-step as described below.

6.5.2 1. Select encoder type P950

In P950 Encoder type, select the encoder you are using. The encoder systems supported are listed in the description of P950.

The connected type can be selected from the list of possible encoders. You must check whether other encoders are suitable and released for use by SEW-EURODRIVE.

6.5.3 2. Set direction of rotation of the motor P35_

Move the drive in the positive direction (defined according to application) at low speed. If the actual position P003 or H511 counts upwards, you do not have to change parameter P350 "Change direction of rotation" (use MOVITOOLS® MotionStudio or DBG11B to display the actual position). Change P350 if the actual position counts downwards. This adapts the counting direction of the motor encoder to suit the application.

6.5.4 3. Set counting direction P951 for the SSI absolute encoder

Move the drive in the positive direction (defined according to application) at low speed. If the absolute encoder position (H509 ACTPOS. ABS) counts upwards, you do not have to change parameter P951 "Counting direction". If the absolute encoder position counts downwards, P951 must be inverted.

6.5.5 4. Set encoder scaling P955

This parameter is irrelevant unless there is a motor encoder (speed control) present. The position information from the absolute encoder is multiplied by this value. The parameter is set so the travel information ratio between the motor encoder and the absolute encoder is as close to "1" as possible.

First, set the parameter to 1. Note down the values of variables H509 (ACTPOS. ABS) and H511 (ACTPOS. MOT). Move the drive by at least 1 motor revolution. Determine the difference between the noted and the current values of the variables and calculate the quotient.

ACTPOS. ABS	H509 old	H509 new	H509 difference
Noted value			
ACTPOS. MOT	H511 old	H511 new	H511 difference
Noted value			

The quotient Q results from the H511 difference divided by the H509 difference.

Q = (H511 old - H511 new)/(H509 old - H509 new)

Set ENCODER SCALING (P955) to the value closest to the calculated quotient Q, preferably to the lower of the closest values.

If the quotient is greater than 80, positioning using the absolute encoder can only be performed with reduced dynamic properties.

INFORMATION

During project planning, ensure that the encoder ratio does not exceed 1:10.

6.5.6 5. Set position offset P953

The position offset (P953) only has to be set on incremental encoders. For other encoders, its should be set to 0.

Proceed as described for P953 in the chapter "IPOS Parameters".

6.5.7 6. Set Zero offset P954

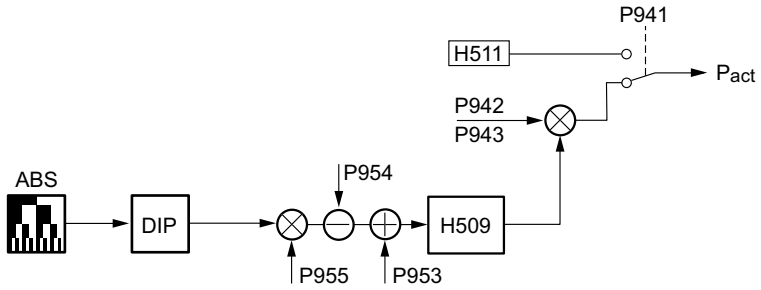
Zero offset is used for assigning the value you want to a specific position. Enter the parameter as described for P954 in the chapter "IPOS Parameters".

6.5.8 7. Set encoder factors P942 and P943

The parameters are used for internal adaptation of the speed control and for monitoring functions in the DIP11.

Practically, this adapts the physical quantity, a mechanical ratio between the motor encoder and external encoder and the mechanical feedrate constant (for example, for external incremental linear encoders).

The following diagram shows the connection between the parameters and variables.



476717707

P_x = Non-linearized position value of encoder
P_{abs} = Actual position value for ramp generator and position controller
P941 = Actual position source
P942 = Encoder factor numerator
P943 = Encoder factor denominator
P953 = Position offset
P954 = Zero offset
P955 = Encoder scaling
H509 = External encoder with actual value on variable
H511 = Motor encoder with actual value on variable

To find out how to determine encoder factors, refer to the parameter descriptions for P942/P943.

6.5.9 8. Set P941 actual position source

This parameter determines which position encoder is used for position control, provided that an "... & IPOS" operating mode has been set in P700 "Operating mode".

There are positioning commands in the IPOS$^{plus®}$ program to control the motor connected to MOVIDRIVE®. Set the Source actual position to "Absolute encoder DIP" if the motor is to be positioned using the absolute encoder.

	INFORMATION The circuit gain for position control of IPOS$^{plus®}$, parameter P910 "Gain X controller" was preset during startup of the speed control loop. This presetting means positioning control is performed with the motor encoder. The difference in encoder resolution or the time characteristics of the absolute encoder (e.g. laser distance measuring instrument) may require a lower value setting.

Set a maximum of half the value of the calculated preset value. If P955 is ≥ 32, only enter a quarter of the calculated preset value. Start an IPOS$^{plus®}$ program with a positioning operation between two valid points at moderate speed. Reduce or increase parameter P910 "Gain X controller" step-by-step until the best movement and positioning characteristics have been set. If P955 is set to a high value, it may be necessary that values in P910 are < 1.

The position value provided by the absolute encoder is available in variable H509 (ACTPOS.ABS). The position value can be processed with the internal IPOS$^{plus®}$ control even without direct positioning.

6.6 Referencing

For applications using absolute positioning commands, you must define the reference point (machine zero). Depending on the encoder type, this setting must either be made at initial startup (absolute encoder) or each time the machine is switched on again (all other encoders).

MOVIDRIVE® supports 9 types of reference travel that can be set via P903 Reference travel type, P904 Reference travel to zero pulse and the arguments of the IPOS$^{plus®}$ command `_Go0 ( ... )`; or `GO0 ...` and that result from the reasonable combination of the following characteristics:

- Encoder is set without reference travel (no reference travel)
- Search direction is set (= direction of movement at start of reference travel)
- Referencing is set to the hardware limit switches
- Referencing is set to zero impulse (only possible in external encoders when the resolution < 5000 inc./revolution)
- Referencing is set to reference cam

If referencing is set to the hardware limit switches and/or the reference cam, these must be set as binary inputs.

Parameter P941 Source actual position is used to define which encoder is used for reference travel.

Once the drive is enabled, reference travel is started using one of the following methods:

- Via a positive edge on binary input P600 ... P606 or P610 ... P617 that is set to the function REF.-FAHRT START
- via the IPOS$^{plus®}$ command `_Go0 ( ... )`; or `GO0 ...`

The display changes to "c" - REFERENCE MODE.

Stop ramp P136 is always used for acceleration during the reference travel. Reference travel types with reference cam or limit switch, accelerate to P901 reference speed 1 and then search for the condition for the end of the reference travel with P902 reference speed 2. Reference type 0, uses P902 Reference speed 2 right away.

If a hardware limit switch is reached during reference travel with type 1 or type 2 and the reference point has not yet been found, the drive turns and continues reference travel in the other direction.

Once the drive has found the reference point, the following functions are performed:

- The drive stops and switches internally from speed to position control.
- Bit 20 "IPOS Referenced" in H473 StatusWord is set and a binary input, with the parameter "IPOS REFERENCE", is set.
- Reference offset P900 is transmitted to the actual position value. If the modulo function is deactivated (P960 = OFF), this is the variable of the encoder H509 - H511 selected in P941. If the modulo function is activated, it is the variable H455 ModActPos.

As of this point, the following formula applies for the machine zero:

Machine zero = reference point + reference offset

The status "referenced" is reset when the inverter is switched off or if error messages relating to the position measuring system occur (exception: for Hiperface® encoders, see the note below).

For advanced users, MOVIDRIVE® offers the option of setting an absolute encoder for which a new encoder offset is calculated and described at the reference point when the drive is not enabled and when it is in the safe stop status, for example. It is also possible to evaluate distance coded encoder systems using complex IPOS$^{plus®}$ programming. If you require support in performing either of these operations, contact SEW service personnel.

	INFORMATION For Hiperface® and SSI absolute encoders, the status "referenced" is always set and is only reset during reference travel.

	INFORMATION The drive reacts differently when the controller inhibit is set during reference travel, depending on how reference travel was started. • If reference travel was started via a positive edge at binary input REF.TRAVEL START or via the non-wait IPOS command `_Go0( ._NW_.. )`; or `GO0...,NW,...`, the reference travel is not continued if the controller inhibit is reset. To start travel, a positive edge must be set at the input REF. TRAVEL START. • If reference travel was started via the wait IPOS command `_Go0( ._W_.. )`; or `GO0...,W,...`, the error message F39 reference travel is generated.

When deciding whether to reference to the reference cam or zero pulse, note the following points:

- The zero pulse moves when the motor is replaced.
- The reference cam could become inaccurate as a result of age, wear or switching hysteresis.
- If the reference point is determined using the zero pulse and reference cam, and the zero pulse is located exactly at the end of the reference cam, the switching transition of the reference cam may be detected before or after the zero pulse (switching hysteresis). The result may be a reference position which varies by a motor revolution from one time to the next. The situation can be remedied by shifting the reference cam (by about half a motor revolution).
- Unidirectional drives can only be referenced using a reference cam. Also note that there is no defined distance between the reference cam and zero pulse of the encoder for non-integer ratios. This means that in this case only the end of the reference cam can be selected as the reference point.
- The length of the reference cam and the reference speeds must be selected so the drive can reliably decelerate to the slower reference speed (reference speed 2) on the reference cam. The end of the reference cam or the closest zero pulse of the encoder system can be used as reference point.
- The zero pulse can only be used as a reference point when the encoder has a zero pulse, the zero track is connected to the inverter and the PPR count < 5000 inc./ revolution.

	INFORMATION In case of reference travel of a drive system with absolute encoder (Hiperface® or DIP), the position offset will be recalculated and overwritten by the reference travel P905 Hiperface® offset X14 / P947 Hiperface® offset X15 or DIP offset P953 Position offset, depending on the source set for the actual position.

	INFORMATION If you change P350/P351 reverse direction of rotation, you have to change these parameters prior to the reference offset or perform the reference offset again after changing the parameters, because this change affects the actual position of the axis.

The following explains the different types of reference travel with different starting points in the drive using travel diagrams.

Explanation of the reference travel type diagrams

- nRef1 =Reference speed 1
- nRef2 =Reference speed 2
- Starting point of the drive
  - [1] Between the reference cam and the right hardware limit switch
  - [2] On the reference cam
  - [3] Between the reference cam and the left hardware limit switch
- LHWLS = CCW hardware limit switch
- RHWLS = CW hardware limit switch
- CAM = Reference cam
- RefCAM = Reference position cam: Movement to this position takes place when the argument of the GO0 reference travel command contains **CAM**.
- RefZP = Reference position zero pulse: Movement to this position takes place when the argument of the GO0 reference travel command contains **ZP**.
- RefOffCAM = Reference offset for reference travel with reference position cam CAM
- RefOffZP = Reference Offset for reference travel with zero pulse ZP
- MZP = Machine zero

6.6.1 Type 0: Reference travel to zero pulse

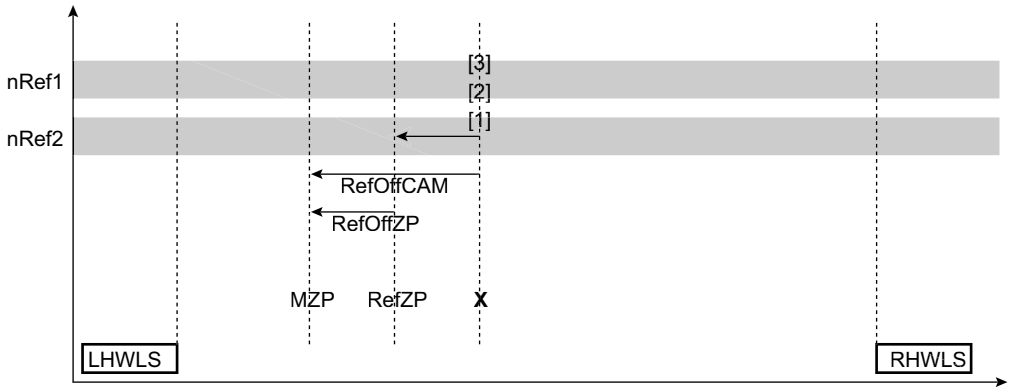
The reference position is the first zero pulse CCW of the starting position of reference travel.

A reference cam is not required. Only P902 Reference speed 2 is used for reference travel.

If reference travel is started via the positive edge at the "REF.TRAVEL START" input, P904 Reference travel to zero pulse should be set to YES.

If the reference travel is started via the IPOS$^{plus®}$ command `Go0`, the argument `"ZP"` should be set, P904 is irrelevant.

If P904 = NO in the first case, or if the argument `"CAM"` is used in the second case, the drive behaves like with type 5 and sets the current position to the reference reference position.



476740875

6.6.2 Type 1: CCW end of the reference cam

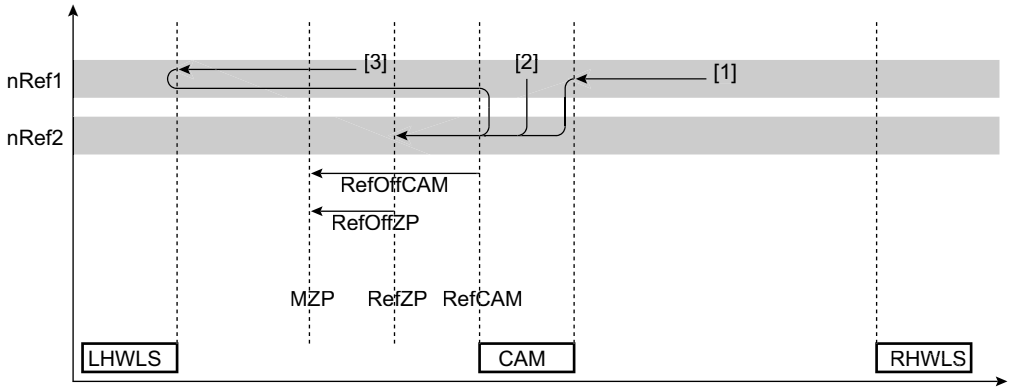
The reference position is the left end of the reference cam or the first zero pulse to the left after the end of the reference cam.

One of the binary inputs P600 ... 606 must be set to "REFERENCE CAM".

Reference travel starts in a CCW direction; P901 Reference speed 1 is used up to the first positive edge of the reference cam, then P902 Reference speed 2 is used.

If reference travel is started via the positive edge on the "REF.TRAVEL START" input, the drive is either referenced to the falling edge of the reference cam or to the zero pulse after the falling edge of the reference cam, depending on the setting in P904 Referencing to zero pulse.

If reference travel is started with the IPOS$^{plus®}$ command `Go0`, the drive is referenced to the falling edge of the reference cam or to the zero pulse after the falling edge of the reference cam, depending on whether the argument `"ZP"` or `"CAM"` is set.



476742795

6.6.3 Type 2: CW end of the reference cam

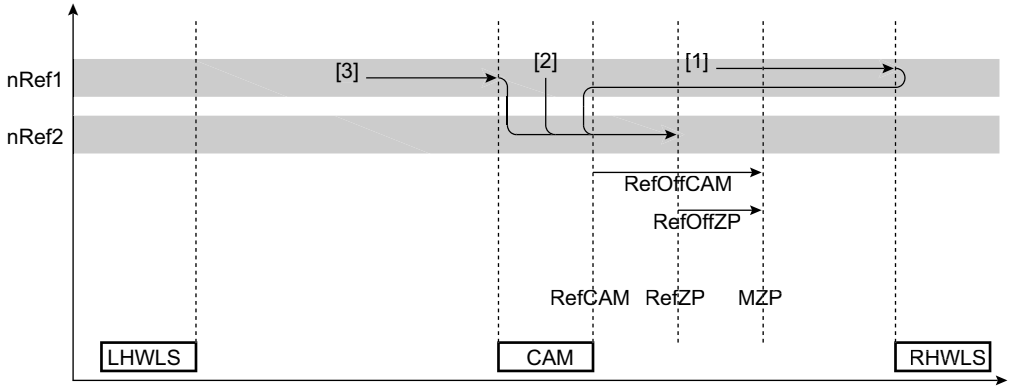
The reference position is the right end of the reference cam or the first zero pulse to the right after the end of the reference cam.

One of the binary inputs P600 ... 606 must be set to "REFERENCE CAM".

The reference travel starts in a CW direction; P901 Reference speed 1 is used up to the first positive edge of the reference cam, then P902 Reference speed 2 is used.

If reference travel is started via the positive edge on the "REF.TRAVEL START" input, the drive is either referenced to the falling edge of the reference cam or to the zero pulse after the falling edge of the reference cam, depending on the setting in P904 Referencing to zero pulse.

If reference travel is started with the IPOS$^{plus®}$ command `Go0`, the drive is referenced to the falling edge of the reference cam or to the zero pulse after the falling edge of the reference cam, depending on whether the argument `"ZP"` or `"CAM"` is set.



476744331

6.6.4 Type 3: CW limit switch

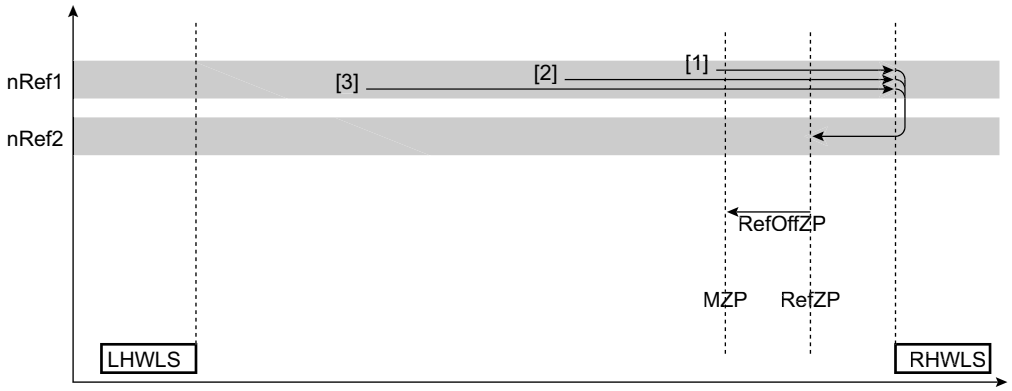
The reference position is the first zero pulse to the left of the CW limit switch.

The setting "Left end of the CW limit switch" is not important because after reference travel, the drive could be located in the switch hysteresis of the limit switch and the error "29 Limit switch reached" could occur sporadically once the reference travel is complete. A reference cam is not required.

Reference travel starts in a CW direction. P901 Reference speed 1 is used up to the falling edge of the CW limit switch, then P902 Reference speed 2 is used.

If reference travel is started via the positive edge at the "REF.TRAVEL START" input, P904 Reference travel to zero pulse should be set to YES.

If the reference travel is started via the IPOS$^{plus®}$ command `Go0`, you have to set the argument `"ZP"`.



476758667

6.6.5 Type 4: CCW limit switch

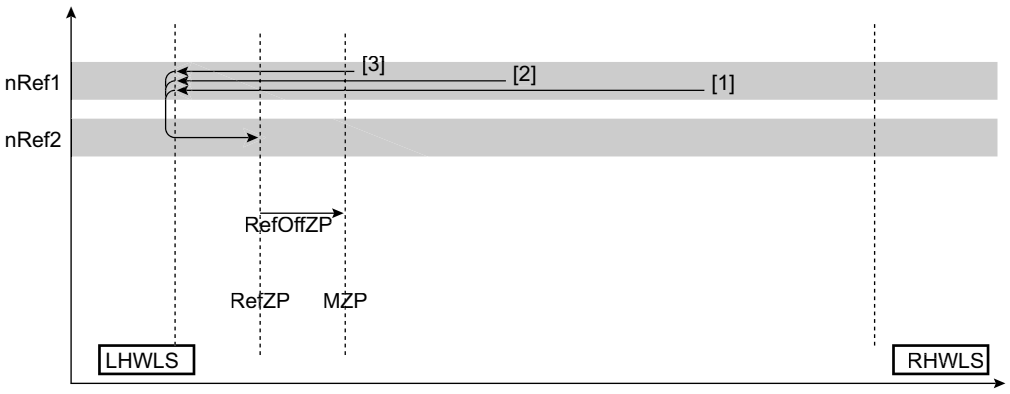
The reference point is the first zero pulse to the right of the CCW limit switch.

The setting "Right end of the CW limit switch" is not important because after reference travel, the drive could be located in the switch hysteresis of the limit switch and the error "29 Limit switch reached" could occur sporadically once the reference travel is complete. A reference cam is not required.

Reference travel starts in a CCW direction; P901 Reference speed 1 is used up to the falling edge of the CCW limit switch, then P902 Reference speed 2 is used.

If reference travel is started via the positive edge at the "REF.TRAVEL START" input, P904 Reference travel to zero pulse should be set to YES.

If the reference travel is started via the IPOS$^{plus®}$ command `Go0`, you have to set the argument `"ZP"`.

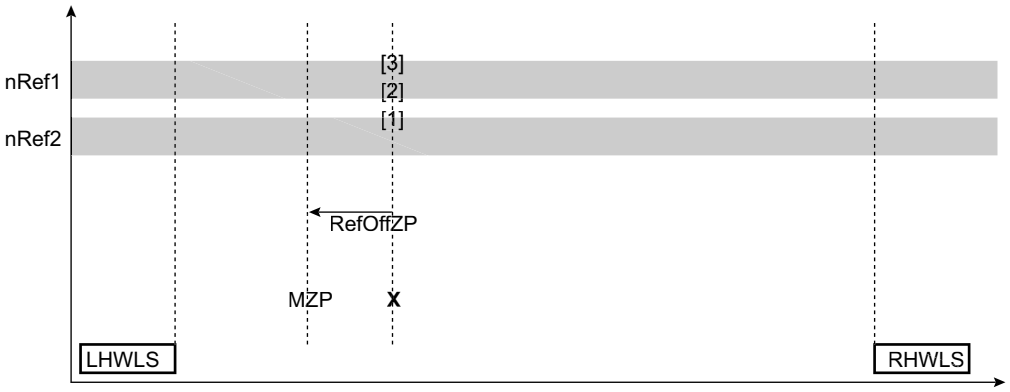


476760203

6.6.6 Type 5: No reference travel

The reference position is the current position. The arguments in the IPOS$^{plus®}$ command `Go0"ZP"` or `"CAM"` and P904 have no effect.

It makes sense to use this type of reference travel with absolute encoders and for drives that are to be referenced at standstill. For example, the position of a feed axis can be set to zero when the drive is at a standstill. In this way, the machine operator can tell where the drive is located within each feed movement..



476761739

6.6.7 Type 6: Reference cam flush with CW limit switch

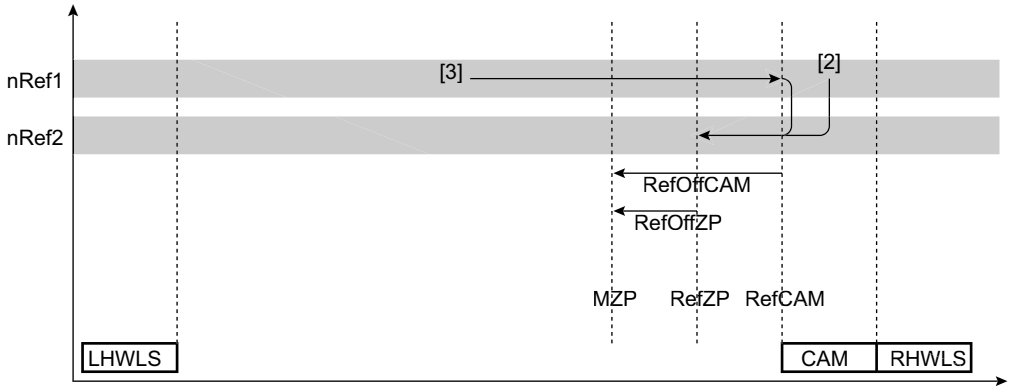
The reference position is the left end of the reference cam or the first zero pulse to the left after the end of the reference cam.

One of the binary inputs P600 ... 606 must be set to "REFERENCE CAM". The reference travel starts in CW direction with P901 reference speed 1 until the first positive edge of the reference cam is reached. Then P902 reference speed 2 is used. As opposed to type 1, the drive starts in CW direction and reverses at the reference cam.

If reference travel is started via the positive edge on the "REF.TRAVEL START" input, the drive is either referenced to the falling edge of the reference cam or to the zero pulse after the falling edge of the reference cam, depending on the setting in P904 Referencing to zero pulse.

If reference travel is started with the IPOS$^{plus®}$ command `Go0`, the drive is referenced to the falling edge of the reference cam or to the zero pulse after the falling edge of the reference cam, depending on whether the argument `"ZP"` or `"CAM"` is set.

The reference cam must start just before or in line with the CW hardware limit switch and must project into the limit switch. This ensures that no contact is made with the hardware limit switch during reference travel.



476763275

6.6.8 Type 7: Reference cam flush with CCW limit switch

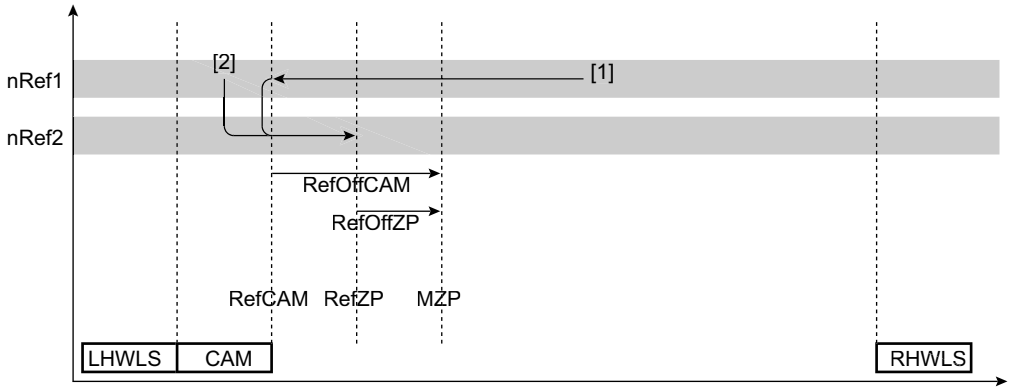
The reference position is the right end of the reference cam or the first zero pulse to the right after the end of the reference cam.

One of the binary inputs P600 ... 606 must be set to "REFERENCE CAM". The reference travel starts in CW direction with P901 reference speed 1 until the first positive edge of the reference cam is reached. Then P902 reference speed 2 is used. As opposed to type 2, the drive starts in CW direction and reverses at the reference cam.

If reference travel is started via the positive edge on the "REF.TRAVEL START" input, the drive is either referenced to the falling edge of the reference cam or to the zero pulse after the falling edge of the reference cam, depending on the setting in P904 Referencing to zero pulse.

If reference travel is started with the IPOS$^{plus®}$ command `Go0`, the drive is referenced to the falling edge of the reference cam or to the zero pulse after the falling edge of the reference cam, depending on whether the argument `"ZP"` or `"CAM"` is set.

The reference cam must start just before or in line with the CCW hardware limit switch and must project into the limit switch. This ensures that no contact is made with the hardware limit switch during reference travel.

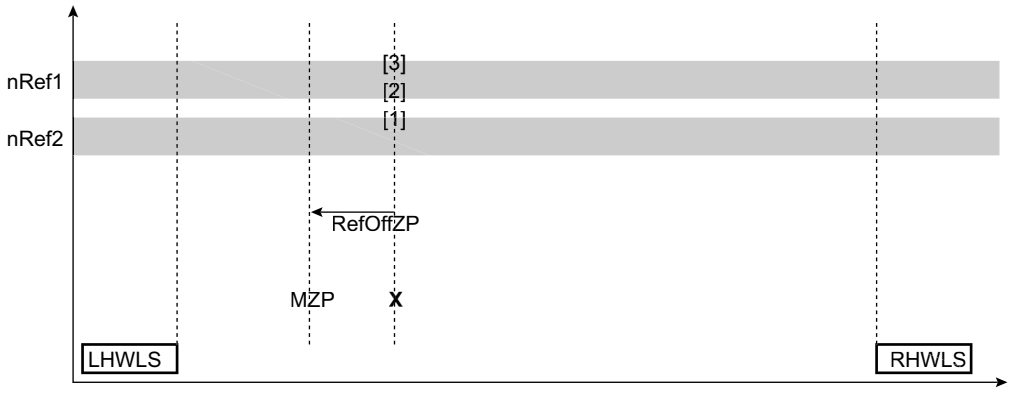


476764811

6.6.9 Type 8: Without enable

The reference position is the current position. The arguments in the IPOS$^{plus®}$ command `Go0"ZP"` or `"CAM"` and P904 have no effect.

It makes sense to use this type of reference travel with absolute encoders and for drives that are to be referenced at standstill. For example, the position of a feed axis can be set to zero when the drive is at a standstill. In this way, the machine operator can tell where the drive is located within each feed movement.



476761739

In contrast to type 5, type 8 reference travel can also be performed when the system status is not set to "A".

6.7 Modulo function

6.7.1 Introduction

The modulo function can be activated for endless unidirectional rotary applications such as, for example, rotary tables or transport chains. This ensures that all position data in the range 0 to (modulo value – 1 incr.) is displayed. When the modulo value defined by the user (for example, 100 mm or 360°) is exceeded, the modulo position value is reset to zero.

It is also possible to use the incremental value of the encoder selected in P941 for positioning and only to activate the modulo function in the background, for example, for counting the revolutions of the output.

The modulo function has the following features:

- Position specification in output units. This can be used to specify a 360° turntable rotation directly without having to convert it into IPOS$^{plus®}$ encoder increments as in the past. For example:
  - Turntable rotation 360° = modulo value = 2^{16} increments.
  - Distance to be covered in one machine cycle = modulo value = 2^{16} increments (rotary table with 4 stations: 1 cycle = 90° = modulo value).
- Permanently accurate positioning without long-term drift or positioning errors, even for non-integer gear unit reduction ratios, as long as the project planning guidelines are adhered to.
- Previous solutions involved mounting an external synchronous encoder or using a digital input to register the zero cross-over, which meant additional programming in IPOS$^{plus®}$.
- Absolute position specification over several revolutions.
- Specification of a travel strategy: The position setpoint can be reached either via the shortest route, or from CW or CCW.

Endless positioning in combination with absolute encoder evaluation via DIP11 is available as of firmware version 14 (822 890 6.14) (fault F92 DIP work area no longer occurs when the modulo function is activated).

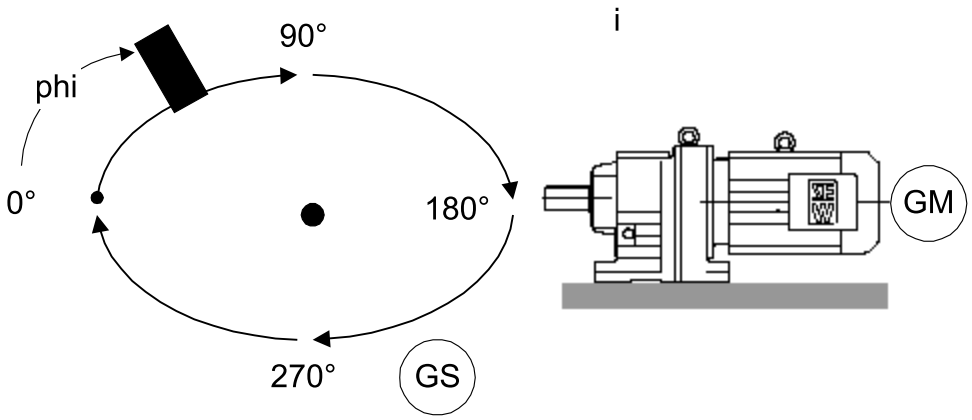
	INFORMATION Depending on the system, the gear unit and, if necessary, any additional gears must be simulated via the number of teeth. Ask the manufacturer of your gear unit for the exact number of teeth. Do not accept the ratio from the nameplate. Furthermore, the maximum target position that can be represented is determined when the gear unit is selected. This value must not be exceeded. This must be taken into account in the project planning phase (see the Project Planning section).

6.7.2 Operating principle

When the modulo function is active, position setpoints are expressed in output units rather than in increments on the motor shaft.

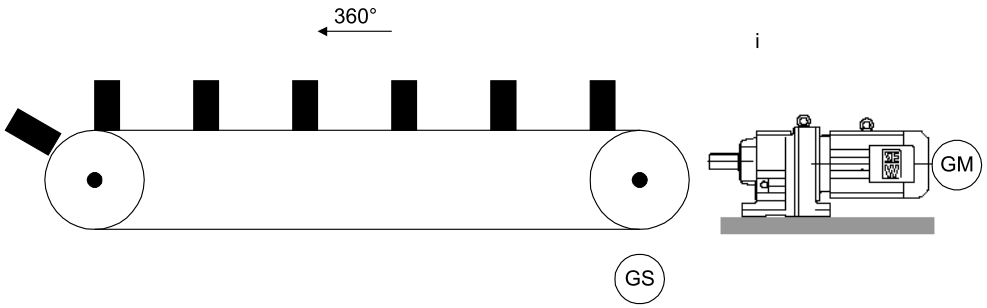
Examples of output units (GM = motor encoder / GS = synchronous encoder):

- Turntable applications with the output unit 360° correspond to one turntable rotation.



476886155

- Conveyor chain with a carrier spacing as output unit.



476887691

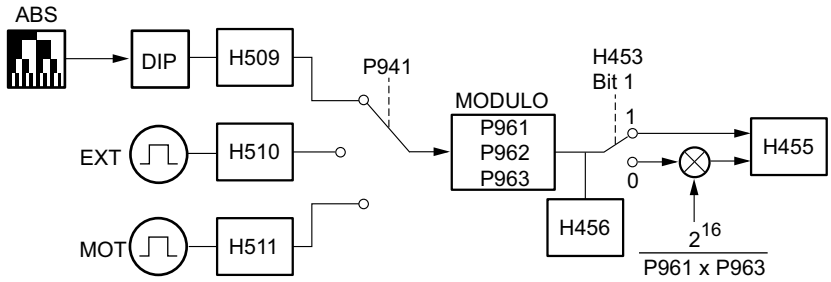
The mechanism of the application is simulated during startup. You have to specify the exact number of teeth of the gear unit and the additional gear if required. This information is represented in the following SHELL parameters:

- Modulo numerator and denominator P961/P962
- Modulo encoder resolution P963

The user can use the following IPOS$^{plus®}$ system variables to specify target positions in output units for the MOVIDRIVE® system software:

- Modulo target position H454 to describe the target position
- Actual modulo position of the output H455 for reading the actual position

The actual position H455 is calculated according to the following block diagram:



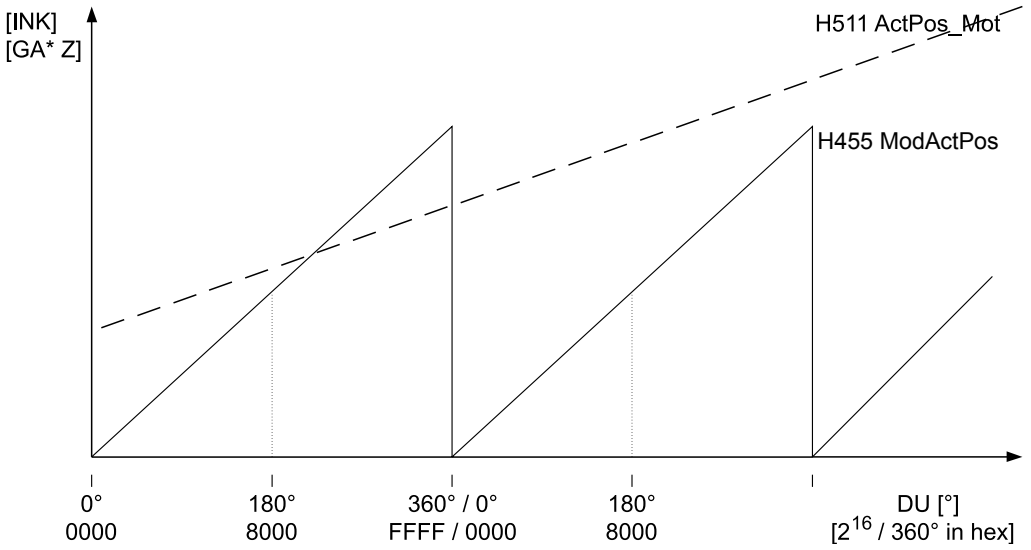
476895243

P941 = Actual position source
P961 = Modulo numerator
P962 = Modulo denominator
P963 = Modulo encoder resolution
H509 = Current actual position, absolute encoder
H510 = Current actual position, external encoder
H511 = Current actual position, motor encoder
H453 = Modulo control
H455 = Actual modulo position, output
H456 = Modulo numerator

	INFORMATION If the drive is to be positioned to the target position in the modulo range, the drive start positioning when the target position is written to variable H454 MOD.TAGPOS. GO commands refer to the IPOS$^{plus®}$ encoder and cannot be used for modulo positioning.

	INFORMATION The following examples use the modulo value 360°. It is also possible to scale to a different physical value other than a modulo value.

The diagram below shows the relationship between the current position of the IPOS$^{plus®}$ encoder, for example, the motor encoder H511 and the actual position in the modulo representation. The actual modulo position always moves within the output unit, for example, from 0° (= 0 increments) to 360° (= 2^{16} increments).



477219595

A new target position is specified by writing the IPOS$^{plus®}$ variable H454 MODTAGPOS in 32-bit format.

The system software differentiates between 2 forms of representation, which can be set in H453, bit 1:

- 360° = 16 bit (referred to below as "2^{16}/360°") standard setting: In this case, the higher value bit range can be used for specifying whole number 360° rotations.
- 360° = 32 bit (referred to below as "2^{32}/360°") standard setting: This notation should be avoided due to the restriction on the maximum range of representation. If used, the product of modulo numerator and modulo encoder resolution corresponds to one 360° revolution.

Sample position selection in output units (in hexadecimal format):

Representation of several integral revolutions **H454 MODTAGPOS = k × 360° + 0 ... 360° = k × 2^{16} + 0 ... (2^{16} -1)** **Representation of one integral revolution** **H454 MODTAGPOS = 0 ... 360°**	
Target position in output unit [°]	Realization via IPOS$^{plus®}$ variable H454 MOD.TAGPOS
360°	0001 0000
3 × 360°	0003 0000
180°	0000 8000
270°	0000 C000

6.7.3 Travel strategies

When the modulo function is activated, a number of travel strategies can be used for positioning. The travel strategy for referencing is dependent on this setting.

Referencing

Reference travel is started in the same way as for referencing without the modulo function. When the modulo function is activated, the H455 MOD.ACTPOS variable is referenced.

If a reference offset is specified in P900, it is interpreted as being in the output unit scaling (2^{16} = 360°).

Once reference travel is complete, the current target position H454 MOD.ACTPOS is set to the actual value MOD.ACTPOS (see section "Referencing").

ACTPOS.MOT H511 is not referenced.

Positioning

The travel strategy for positioning is selected via the SHELL parameter 960 Modulo function. The modes can be changed using an IPOS$^{plus®}$ program with the MOVILINK command (see section "User interface"). The examples refer to the selected resolution (2^{16}/360°).

A motor encoder has been entered as the IPOS$^{plus®}$ encoder (P941 Source actual position = MOTOR ENC. (X15)).

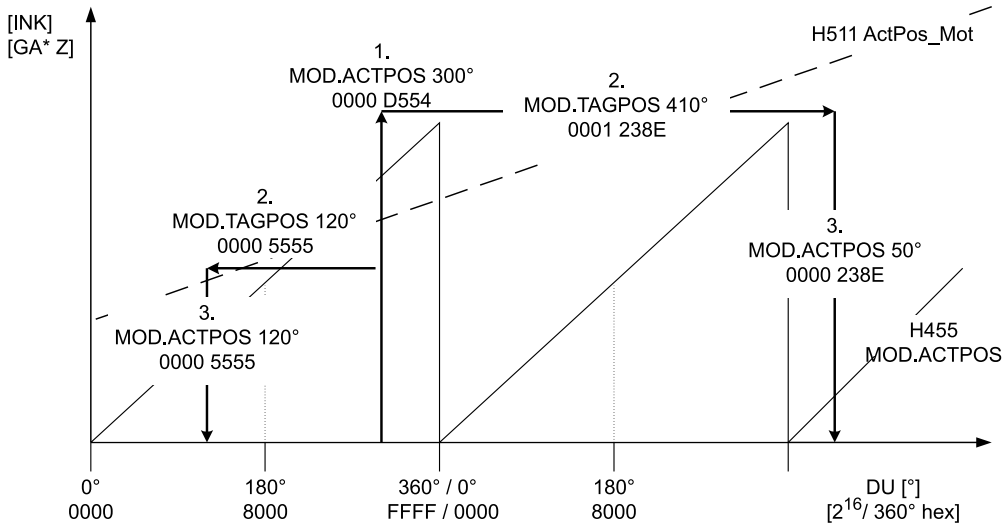
"Short distance"

Modulo mode "Short distance" (P960 = SHORT) – standard setting

Starting from the current actual position H455 MOD.ACTPOS, the system calculates the shortest route to the required target position H454 MOD.TAGPOS. The direction of rotation is selected on the basis of the shortest route.

Target position that can be represented:

H454 MOD.TAGPOS = k × 360° + 0 ... 360° = k × 2^{16} + 0 ... (2^{16} - 1)



477225739

1. Actual position prior to positioning — Modulo actual position
2. Definition of target position — Modulo target position
3. Actual position after positioning — Modulo actual position

Modulo short route (note: when MOD.TAGPOS = 120° the axis only moves in a counterclockwise direction when the drive is positioned at least 1 increment CCW of 300°, since 300° + 180° = 120° and 300° 180° = 120°).

Therefore, to position an axis that is at 0°, 1 revolution in a clockwise direction, H454 must be set to 0x 10000. To move this axis 1 revolution CCW, H454 must be set to 0x FFFF0000.

"CW"

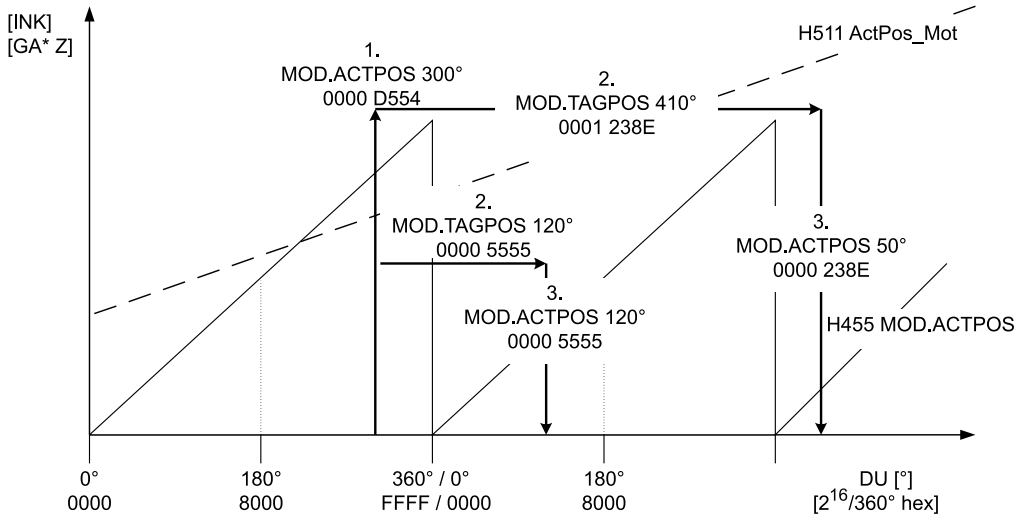
Modulo mode "CW" (P960 = CW)

The drive moves from the current actual position H455 MOD.ACTPOS clockwise to the target position H454 MOD.TAGPOS.

Target position that can be represented:

H454 MOD.TAGPOS = k × 360° + 0 ... 360° = k × 2^{16} + 0 ... (2^{16} - 1)

Only positive values are permitted in the high part. If this condition is not met and the sign bit 2^{32} is set, the drive inverter displays the fault status (IPOS$^{plus®}$ program error).



477230091

1. Actual position prior to positioning Modulo actual position
2. Definition of target position Modulo target position
3. Actual position after positioning Modulo actual position

"CCW"

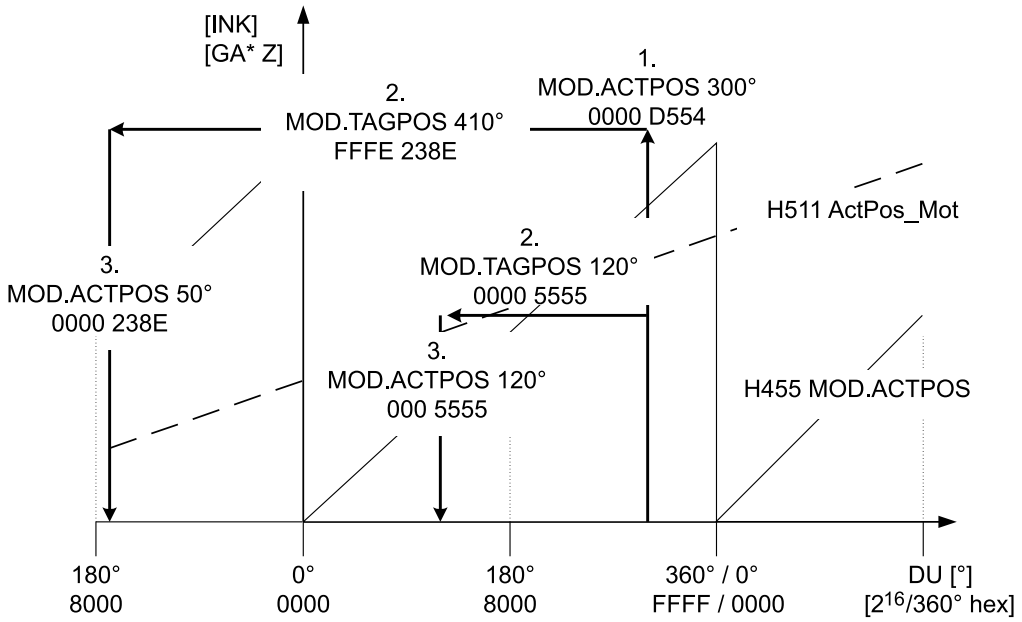
Modulo mode "CCW" (P960=CCW)

The drive moves from the current actual position H455 MOD.ACTPOS counter-clockwise to the target position H454 MOD.TAGPOS.

Target position that can be represented:

H454 MOD.TAGPOS = - k × 360° + 0 ... 360° = - k × 2^{16} + 0 ... (2^{16} - 1)

Only negative values are permitted in the high part. If this condition is not met and the sign bit 2^{32} is not set, the drive inverter displays the fault status (IPOS$^{plus®}$ program error).



477247627

Parameters and variables

Parameters and variables for the modulo function

See sections "IPOS$^{plus®}$ Parameters" and "System Variables".

Parameter no.	Name
P 960, Index 8835	Modulo control
P 961, Index 8836	Modulo numerator
P 962, Index 8837	Modulo denominator
P 963, Index 8838	Modulo encoder resolution

INFORMATION

To use the modulo function, the peripheral condition of the product of modulo encoder resolution and modulo numerator < 2^{31} must be fulfilled.

Variable no.	Name
H453	MODULOCTRL
H454	MOD.TAGPOS
H455	MOD.ACTPOS
H456	MODCOUNT

6.7.4 Project planning

Definition of drive unit
- Gear unit and the additional gear make up the output unit 360°
- Determine the maximum target position in "Number of drive units"
- Determine 16 bit or resolution (encoder x modulo numerator) for 360°

↓

Determining the SHELL modulo parameters
- Modulo function P960 (select travel strategy)
- Modulo numerator P961
- Modulo denominator P962
- Modulo encoder resolution P963

Resources for determining the number of teeth in the gear unit:
- SEW Technical Manual
- SEW Wingear program to reduce the numerator/denominator factors

↓

Modulo range of representation and maximum output position
- Condition for the range of representation: Modulo encoder resolution x modulo numerator < 2^{31}
- Condition for maximum output position: = 2^{31} / (modulo encoder resolution × modulo numerator)

If this condition is not met, it can lead to positioning errors!

↓

Realization in the IPOS$^{plus®}$ program
- Specify setpoint position with the H454 ModTagPos variable: MOD.TAGPOS = k × 360° + 0 ... 360° = k × 2^{16} + 0 ... (2^{16} - 1)
- Read off the actual position in the H455 ModActPos variable: MOD.ACTPOS = ... + 0 ... 360° = ... + 0 ... (2^{16} - 1)

The system software reads the target position specified in ModActPos and then sets the high word to 0.

The actual position ModuloActPos always moves between 0° and 360°!

6.7.5 Project planning examples

Chain conveyor

Step 1: Defining the output unit

The positions for a chain conveyor are specified in output units. A 360° rotation at the gear unit output corresponds to the modulo output unit of 360°.

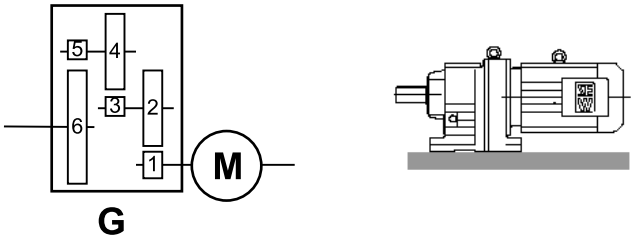
Step 2: Determining the SHELL parameters

Technical data	
Gear unit type	KA47B
Output speed [rpm]	19
Motor speed [rpm]	2000
Gear unit reduction ratio i	104.37
Motor type	DY71S

SEW employees can read off the number of teeth in the gear unit from the SEW Technical Manual (DriveNet) or from the electronic nameplate (only for Hiperface®).

In this example, the following numbers of teeth were ascertained:

Z1 = 17 / Z2 = 74 / Z3 = 8 / Z4 = 33 / Z5 = 16 / Z6 = 93



477251979

The following calculations must be performed to determine the SHELL parameters modulo numerator, modulo denominator and modulo encoder resolution:

$$\frac{M_N}{M_D} = i_G \times i_{AG}$$

$$\frac{M_N}{M_D} = \frac{Z_2 + Z_4 + Z_6}{Z_1 + Z_3 + Z_5}$$

$$\frac{M_N}{M_D} = \frac{227106}{2176} = \frac{113553}{1088}$$

M_N = Modulo numerator
M_D = Modulo denominator
i_G = i gear unit
i_{AG} = i additional gear

The numerator and denominator were reduced in the above example (happens automatically with the Wingear program).

This results in the following input values for the SHELL parameters:

- Modulo numerator = 113553
- Modulo denominator = 1088
- Modulo encoder resolution = 4096

Step 3: Modulo range of representation and maximum target position

Check the modulo range of representation:

The product of the modulo encoder resolution and modulo numerator must be < 2^{31} (decimal 2147483648).

Modulo numerator x modulo encoder resolution = 113553 × 4096 = 465113088

=> The condition has been met, the target position can be represented.

Check the maximum target position:

$$TP_{max} = \frac{2^{31}}{M\,360^\circ} = \frac{2^{31}}{M_N \times M_{ER}} = \frac{2^{31}}{113553 \times 4096} = 4.6$$

TP_{max} = maximum target position
M = Modulo
M_N = Modulo numerator
M_{ER} = Modulo encoder resolution

The maximum target position corresponds to 4.6 output revolutions.

Chain conveyor with carrier

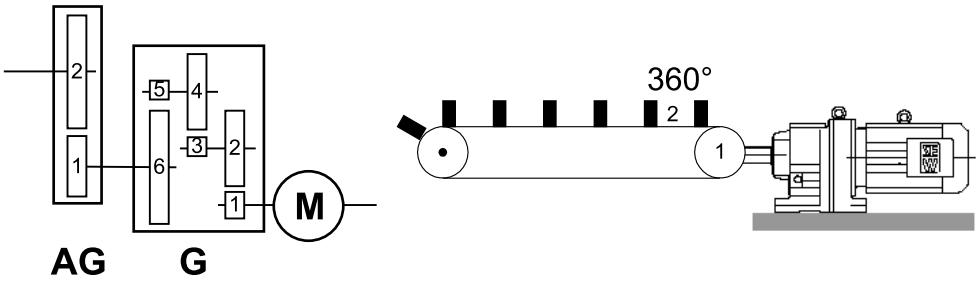
Step 1: Defining the output unit

Now, the previous example shall be extended:

A gear wheel is mounted to the gear unit that drives a chain. There are 35 chain links between each carrier.

Step 2: Determining the SHELL parameters

Technical data	
Gear unit type	KA47B
Output speed [rpm]	19
Motor speed [rpm]	2000
Gear unit reduction ratio i	104.37
Motor type	DY71S



477253515

Number of teeth of the additional gear chain sprocket: $Z_{AG}1 = 5$

Carrier spacing in chain links: $Z_{AG}2 = 36$

i additional gear = 5/36

$$\frac{M_N}{M_D} = i_G \times i_{AG}$$

$$\frac{M_N}{M_D} = \frac{Z_2 + Z_4 + Z_6}{Z_1 + Z_3 + Z_5} \times \frac{Z_{AG}2}{Z_{AG}1}$$

$$\frac{M_N}{M_D} = \frac{1021977}{1360}$$

Modulo numerator = 1021977

Modulo denominator = 1360

Modulo encoder resolution = 4096

Step 3: Modulo range of representation and maximum target position

Check the modulo range of representation:

The product of the modulo encoder resolution and modulo numerator must be < 2^{31} (decimal 2 147 483 648).

Modulo numerator x modulo encoder resolution = 1021977 × 4096 = 4 186 017 792

The condition has not been met, the required target position cannot be represented. This application would result in positioning errors. The system sets the +/- bit when a value is specified, for example, a target position of 180°; the drive is positioned incorrectly.

Solution: Select a gear unit with a different ratio.

The target position that can be represented can be increased by selecting another gear unit with different division factors for the number of teeth (i.e. parts of the numbers of teeth would cancel one another out in the calculation).

6.7.6 Frequently asked questions

- Is there a complete program to use with the modulo function?
  - Yes, the "Modulo Positioning" application module with optional control via fieldbus or hardware terminal.
- Why is it recommended to set P960 to SHORT?
  - The travel strategy is adhered to strictly when the target position is set during standstill. If the drive is set to P960 = CW, for example, when the target position is set, only one increment CW away, the drive moves through a complete rotation.
- Why does positioning not start once the target position has been sent?
  - The drive must be started in the "... & IPOS" operating mode.
  - A travel strategy must be selected via SHELL P960.
  - Before setting the H454 ModTagPos IPOS$^{plus®}$ variable, the drive inverter must be in the status A "Technology option".
- Can the target position be written cyclically?
  - For targets in the range 0° to 359,999° or 0 increments ... 65535 increments: Yes.
  - If target positions ≥ 360° are written cyclically, this causes "Endless positioning".
- Can incremental positioning be performed if the modulo function is activated?
  - Yes, but to avoid unwanted "Cross effects", modulo positioning should be switched off in the SHELL parameter 960.
  - After the reference travel, only the IPOS$^{plus®}$ variable H455 MOD.ACTPOS is set to 0, NOT the incremental actual position ACTPOS.MOT in variable H511.
- What causes the error IPOS-ILOOP F10?
  - The interpreter of the IPOS program detects a command with invalid operands.

- How can positioning be continued once the enable has been revoked?
  - Set the bits H453.0 (ModuloCtrl variable and TargetReset_Off bit).
- How does the axis act when the _AxisStop(AS_PSTOP) command is activated during positioning?
  - The drive waits at the positioning ramp; the actual position is displayed when the axis stops. To continue positioning, the target position must be given a new value (for example, change the increment value by 1 bit). Instead of using the _AxisStop(AS_PSTOP) command, use _AxisStop(AS_RSTOP). In this case, the target position would be stored when the H453.0 bits (ModuloCtrl variable and TargetReset_Off bit) were activated.

6.8 Cam controllers

You can use cam controllers to set or reset outputs depending on the position of a drive. This function lets you control additional actuators, such as pneumatic cylinders, start a second axis (e.g. for rounding the path contour in a xy portal) or monitor two axes in the same operating range for collision.

Each MOVIDRIVE® comes equipped with a standard cam controller with one output. A new output is formed every time the command is processed in the IPOS$^{plus®}$ program. An unlimited number of outputs is theoretically possible, but the number of outputs is practically limited by the IPOS$^{plus®}$ program length and the acceptable execution time.

New MOVIDRIVE® units (MDx_A / MCV / MCS / MCF as of version .14, MCH as of version .13 and MDx_B) and the technology options have an expanded cam controller with eight outputs that is cyclically calculated in the background by the firmware.

You initialize a cam controller in the drive and evaluate the status of the cams with the GETSYS command.

The GETSYS command accesses a data structure. The bit with the highest value of the first variable in this data structure decides which cam controller the GETSYS command refers to (Bit 31 = 0: Standard cam control with bit 31 = 1: Expanded cam control).

If both cam controllers are available in the unit on site, SEW recommends to initially use the expanded cam control. It is also possible to use both cam controllers at the same time. The outputs of both cam controllers can be issued on the same binary output word by issuing the outputs of the standard cam controller in the lower 2 bits and the outputs of the expanded cam controller in the higher 4 bits, shifted two places to the left.

INFORMATION

If the output bit of a cam is copied to a binary terminal output, the output is set 1 ms later, as with all bits that are copied to outputs in IPOS$^{plus®}$.

6.8.1 Standard cam controller

Characteristics of the standard cam controller

- It is available with encoder for all operating modes.
- Per declaration and request of a data structure, one output with delay compensation is set or reset depending on the four position windows (defined by a CCW and CW limit value).
- The limits of the positioning window can be altered during the execution time and will be taken into consideration with the next GETSYS command. This option makes it possible to use other cam areas for the return travel in case of a reversing axis.
- The cam output can be assigned to any bit of a variable.
- An unlimited number of outputs is theoretically possible, but the number of outputs is practically limited by the IPOS$^{plus®}$ program length and the acceptable execution time.
- A new output will be formed with the GETSYS command, regardless of whether the drive is referenced or not.
- The GETSYS command initializes the function and forms the new status of the output a single time once the command is given. The command must be activated every time a new status is required in the IPOS$^{plus®}$ program – the new generation of the cam output depends on the program cycle time.
- The reference value can be set, typical reference sizes are:
  - H511 - Current actual position, motor encoder
  - H510 - Current actual position, external encoder
  - H509 - current actual position, SSI absolute encoder (DIP11A option)
  - H455 - Current actual position, motor encoder in modulo format
  - H376 - Current actual position, master value (only for the technology functions electronic cam or internal synchronous operation)
- The cam outputs keep their values in between the GETSYS commands and are only deleted after a reset.
- If the cam function is activated n times per 1 ms, n cam outputs can be generated (e.g. in a quick task, such as task 3 in MOVIDRIVE® B, which can process several IPOS$^{plus®}$ commands per 1 ms). Since MOVIDRIVE® generates a new position value every 1 ms, all of the commands processed during the 1 ms period operate with the same position value.

Startup of the cam controller

Compiler: _GetSys(Cam1 ,GS_CAM);

initializes the cam controller and generates the status of an output with the data structure as of the variable cam1

Assembler: GETSYS Hxx = CAM

initializes the cam controller and generates the status of an output with the data structure as of the variable Hxx

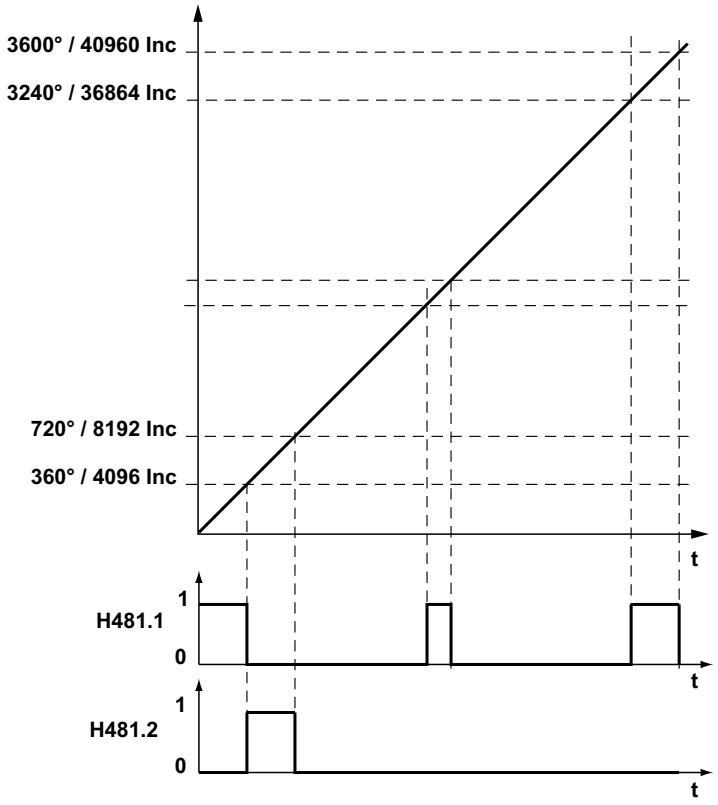
Data structure of the standard cam controller

Variable	Symbolic name of the element in the SEW standard structure	Brief description
H+0	GSCAM.SourceVar	Number of the reference variable for the cam calculation, typical reference variables are: • H511 (Actual position, motor encoder) • H510 (Actual position, SSI encoder) • H509 (Actual position, external encoder) • H455 (Actual position, motor encoder in modulo format) e.g. H+0 = 511 for reference size H511, bit 31 of the variable must be 0!
H+1	GSCAM.DbPreCtrl	Delay time compensation in 0.1 ms to compensate the delay time of an actuator connected to the inverter. The output is preset, depending on the rate of change of the reference variable value, in such a way that the output is switched in advance by this time interval.
H+2	GSCAM.DestVar	Number of variables in which the output will be set or reset
H+3	GSCAM.BitPosition	Position of the bit in variable H+2; if the cam output is assigned to a unit output (e.g. H481), this binary output is to be reserved with P620 – P639 as an IPOS$^{plus®}$ output.
H+4	GSCAM.BitValue	Polarity of the output, 0 = bit set, if the reference variable H+0 has been set within the position window H+6 to H+13 1 = bit set, if reference variable H+0 outside the position window H+6 to H+13
H+5	GSCAM.NumOfCam	Number of the position windows defined in H+6 to H+13; the left limit value must always be smaller than the right one. If a modulo axis requires a position window that exceeds the 360° - 0° limit, then this range will have to be divided into two position windows. This process lets the operator set three related ranges for this output.
H+6	GSCAM.PosL1	CCW limit value of the first position window.
H+7	GSCAM.PosR1	CW limit value of the first position window
H+8	GSCAM.PosL2	CCW limit value of the second position window
H+9	GSCAM.PosR2	CW limit value of the second position window
H+10	GSCAM.PosL3	CCW limit value of the third position window
H+11	GSCAM.PosR3	CW limit value of the third position window
H+12	GSCAM.PosL4	CCW limit value of the fourth position window
H+13	GSCAM.PosR4	CW limit value of the fourth position window

Example

A travel drive has a travel range of ten motor revolutions.

An output is to be set when the drive is in the first and in the last motor revolution or in a range of +/- 10° around the center of the travel range. A second output is to be set when the drive is in the second revolution.



477561867

Required parameter settings

P620 = IPOS$^{plus®}$ output

P621 = IPOS$^{plus®}$ output

Example solved in the Compiler

```
/*============================================
IPOS source file
============================================*/
#include <const.h>
#include <io.h>
//Declaration
GSCAM Cam1, Cam2;   //Declaration of cam outputs 1 and 2
/*============================================
Main function (IPOS initial function)
============================================*/
main()
{
 /*-----------------------------------
 Initialization
 -----------------------------------*/
 °°Cam1.SourceVar = numof(ActPos_Mot); // Reference size motor encoder
   Cam1.DbPreCtrl = 0; // no delay time compensation
  Cam1.DestVar = numof(StdOutpIPOS); // Output onf Do01 (H481.1)
 °°Cam1.BitPosition = 1;
 °°Cam1.BitValue = 0; // Output = 1, if value in window
   Cam1.NumOfCam = 3; // Number of windows
  Cam1.PosL1 = 0; // 1st window, left limit value
 ° Cam1.PosR1 = 4096; // 1st window, right limit value
 ° Cam1.PosL2 = 20366; // 2nd window, left limit value
 ° Cam1.PosR2 = 20594; // 2nd window, right limit value
 ° Cam1.PosL3 = 36864; // 3rd window, left limit value
 °Cam1.PosR3 = 40960; // 3rd window, right limit value
 °°Cam2.SourceVar = numof(ActPos_Mot); // Reference size motor encoder
   Cam2.DbPreCtrl = 0; // no delay time compensation
 ° Cam2.DestVar = numof(StdOutpIPOS); // Output onf Do02 (H481.2)
 °°Cam2.BitPosition = 2;
 °°Cam2.BitValue = 0; // Output = 1, if value in window
   Cam2.NumOfCam = 1; // Number of windows
 ° Cam2.PosL1 = 4096; // 1st window, left limit value
 ° Cam2.PosR1 = 8192; // 1st window, right limit value
 /*-----------------------------------
 Main program loop
 -----------------------------------*/
 while(1)
 {
      _GetSys(Cam1 ,GS_CAM ); // Form output of first cam
      _GetSys(Cam2 ,GS_CAM ); // Form output of second cam
 }

}
```

Example solved in the Assembler

(The SET command is not necessary and serves demonstrative purposes only)

```
SET     H13   = H511
GETSYS  HO    = CAM
GETSYS  H14   = CAM
END
```

Identifier		Value
HO	Source-Va	13
H1	DbPreCont	0
H2	Dest.-Var	481
H3	Bit-Posit	1
H4	Bit-Polar	0
H5		3
H6		0
H7		4096
H8		20366
H9		20594
H10		36864
H11		40960
H12		0
H13		4016
H14	Source-Va	511
H15	DbPreCont	0
H16	Dest.-Var	481
H17	Bit-Posit	2
H18	Bit-Polar	0
H19		1
H20		4096
H21		8192

477809419

6.8.2 Expanded cam controller

Characteristics of the expanded cam controller

- Is available as of MDx_A / MCV / MCS / MCFsoftware version .14, MCH as of software version .13 and MDx_B.
- Is available for CFC or Servo operating modes with technology options.
- Eight outputs (cam bits) are available.
- Up to four position windows and a delay time compensation can be defined for each output (corresponds to four cams on a mechanical cam disk).
- The outputs 1-4 are processed every 1 ms; outputs 5-8 every 4 ms.
- The GETSYS command initializes and starts the function. The cams are generated with the fixed time interval in the background and do not depend on the cycle time of the IPOS$^{plus®}$ program. Assign useful values to the data structures prior to their first invocation.

- Any changes in the data structure will be adopted every 1 ms. This step changes the limits of a position window during the execution time; these will be considered during the next processing cycle of the cam. This option makes it possible to use other cam areas for the return travel in case of a reversing axis.
- All outputs can be stored contiguously from any bit of a variable.
- It is possible to set outputs, i.e. to fix their setting to 1 or 0 in the program.
- The reference value can be set, typical reference sizes are:
  - H511 - Current actual position, motor encoder
  - H510 - Current actual position, external encoder
  - H509 - Current actual position, SSI absolute encoder (DIP11A option)
  - H455 - Current actual position, motor encoder in modulo format
  - H376 - Current actual position, master value (only for the technology functions electronic cam or internal synchronous operation)
- You can stop the expanded cam function by calling up GETSYS with bit 31 = 0. This step stops processing in the firmware and the function no longer requires any processor capacity. If, however, the CamState is assigned 0x8000 0000, the cam function will also be stopped but runs in the background without setting any outputs.

Starting the expanded cam control

Compiler: _GetSys(CamArray ,GS_CAM);

Initializes the cam controller and generates the status of all outputs with the data structure as of the variable CamArray

Assembler: GETSYS Hxx = CAM

Initializes the cam controller and generates the status of all outputs with the data structure as of the variable Hxx

Data structure of the expanded cam control

The expanded cam function is configured with the help of two data structures, i.e. the CamControl structure and the CamOutput structure.

- The CamControl structure controls the global behavior of the expanded cam function.
- The CamOutput structure is used to define an output (output of the cam disk) and may be required up to eight times.

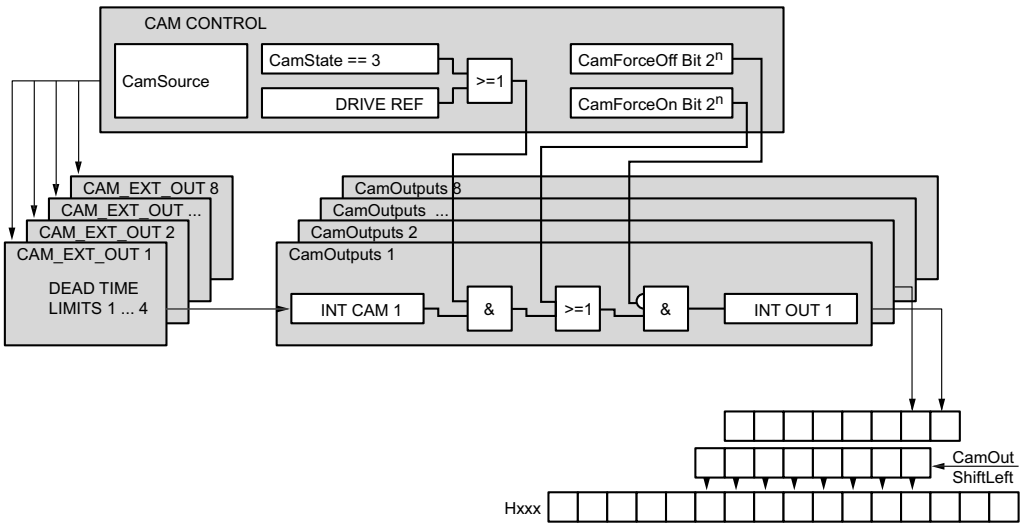
SEW standard structure GSCAM_EXT

Variable	Name	Description
H+0	CamState	Bit 31 must always be set, otherwise processing in the firmware stops. • 0x8000 000**0** = function inactive, no new cam outputs will be generated, set outputs will be retained and only deleted after a reset or voltage off/on. • 0x8000 000**1** = function active, but all cam outputs will be turned off. • 0x8000 000**2** = function active, if drive is referenced (H473, Bit20 =1) • 0x8000 000**3** = function active even without referenced drive
H+1	CamReserved1	Reserved
H+2	CamOutShiftLeft	Shifts the internal data buffer of the outputs by n digits to the left prior to writing to the target variable H+6. NOTICE: The shifting process will delete the information of the upper outputs. This means that if the shift factor is 3, the upper 3 outputs with 4 ms cycle time are no longer available, and the 4 outputs with 1 ms cycle time are assigned to bits 3 - 6 and the output with 4 ms cycle time is assigned to bit 7.
H+3	CamForceOn	Mask to force mandatory outputs. The mask takes effect on the internal data buffer prior to shifting with H+2 (NOT on the target variable defined with H+6)
H+4	CamForceOff	Mask to force deletion of outputs. The mask takes effect on the internal data buffer prior to shifting with H+2 (NOT on the target variable defined with H+6) CamForceOff dominates CamForceOn
H+5	CamSource	Bit 31 switches between preset reference variables and an indicator to a random reference variable. Bit 31= 0: • 0 = encoder X15 (motor encoder, H511) • 1 = encoder X14 (external encoder, H510) • 2 = encoder H509 (absolute encoder DIP11A) • 3 = virtual encoder • all following values are reserved! Bit 31= 1: CamSource includes a pointer to one IPOS$^{plus®}$ variable +2^{31}
H+6	CamDestination	Pointer to target variable. The bits not used in the target variables are available for other functions (if you shift the outputs by four to the left with Shift Left, it frees up bits 0-3, bits 4-7 are available for the cam functions and bits 8-31 are available for any assignment. If the cam outputs are assigned to unit outputs (e.g. H481), you will have to reserve these binary outputs with P620 - P639 as IPOS outputs. The bits not used in this word are available for other outputs.
H+7	CamOutputs	Number of outputs (max. 8)
H+8	CamData 1	Pointer to first CamOutput structure (first output)
...	...	
H+15	CamData 8	Pointer to last CamOutput structure (eighth output)

Structure CAM_EXT_OUT

Variable	Name	Description
H+0	DeadTime	Delay time compensation for this channel (-500 ms..0..+500 ms) to compensate the delay time of an actuator connected to the inverter. The output is preset, depending on the rate of change of the reference variable value, in such a way that the output is switched in advance by this time interval.
H+1	CamAreas	Number of position windows for this channel (1 ... 4); the CCW limit value must always be lower than the CW limit value. If a modulo axis requires a position window that exceeds the 360° - 0° limit, then this area will have to be divided into two position windows. This process lets the operator set three related ranges for this output.
H+2	LeftLimit1	CCW limit, window 1
H+3	RightLimit1	CW limit, window 1
...	...	...
H+8	LeftLimit4	CCW limit, window 4
H+9	RightLimit4	CW limit, window 4

Function chart of the expanded cam control



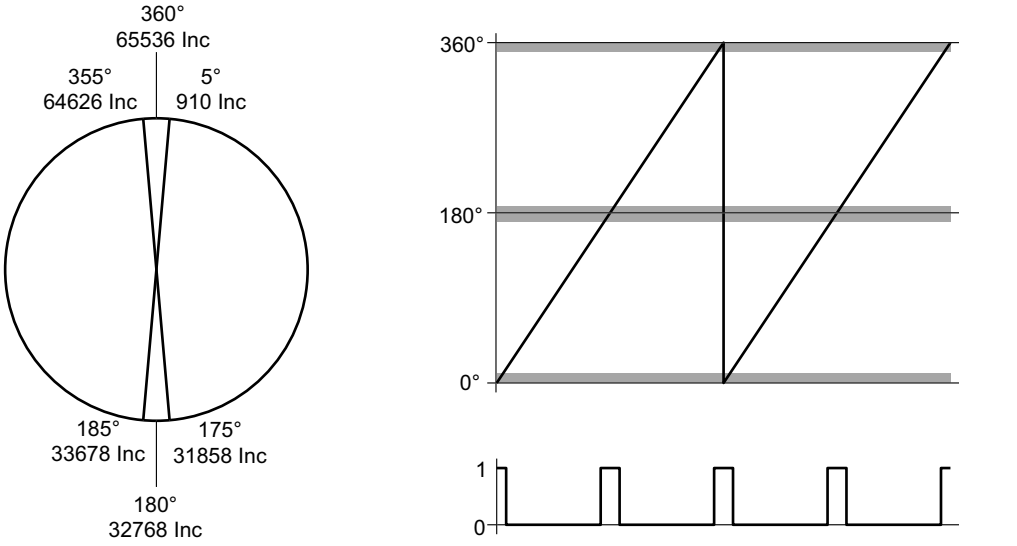
477814283

INT CAM 1: Internal cam signal 1
INT OUT 1: Internal output signal 1
Hxxx: Output variable defined with CamDestination

Example

A modulo rotary table has two processing stations installed 180° apart from each other. It is driven by a gear unit with a ratio of 1:5. An output is to be set when the drive is in the +/-5° range of the stations.

(Comment: an active modulo function will resolve a full load rotation of 360° with 65536 increments see modulo function)



477818635

Required parameter settings

P620 = IPOS$^{plus®}$ output

P960 = e.g. SHORT

P961 = 5

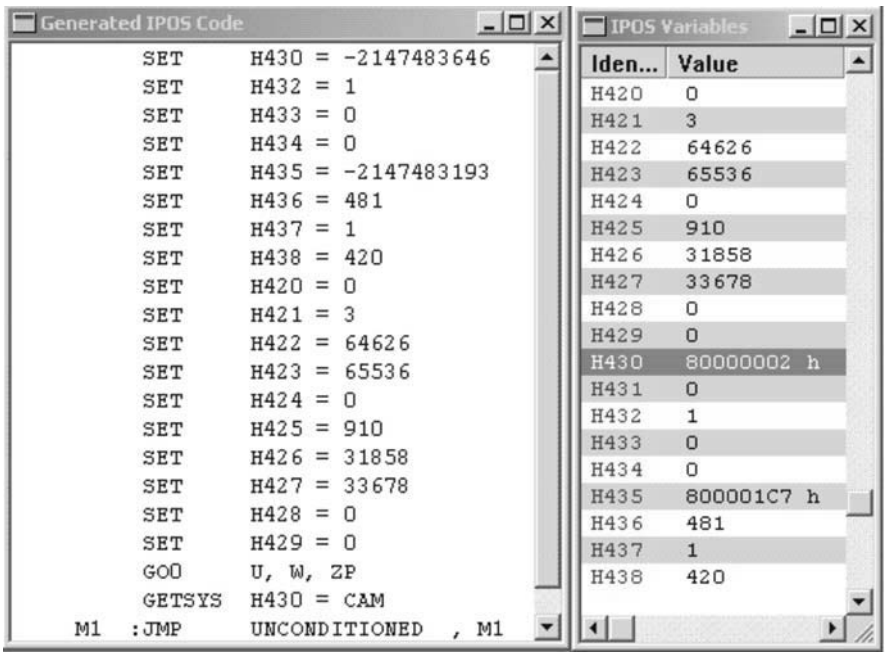
P962 = 1

P963 = 4096

Example solved in the Compiler

```
/*
=========================================================================
Program frame for applications with expanded cam function
=========================================================================
*/
#include <const.h>
#include <io.h>
// Variable structure for the cam controller defined externally in *.h
#include <camdef.h>
CamStructure CamData0;
ControlStructure MyCamControl;
/*=============================================
Main function (IPOS initial function)
=============================================*/
main()
{
 /*-------------------------------------
 Initialization
 -------------------------------------*/
 MyCamControl.CamControl=0x80000002;        // exp. function active
 MyCamControl.CamOutShiftLeft=1;
 MyCamControl.CamForceOn=//Mandatory activation of mask
 MyCamControl.CamForceOff=0; // Mask: Mandatory deactivation of outputs
 MyCamControl.CamSource=numof(ModActPos) | (1<<31);
 // Actual position value in modulo format
 MyCamControl.CamDestination=481;  // Basic unit outputs
 MyCamControl.CamOutputs=1; // Number of cam discs (max. 8)
 MyCamControl.CamDataStr0=numof(CamData0);
 // Start of the cam structure 1 (output bit 0)
   CamData0.DeadTime=0;
 CamData0.CamAreas=3; // 3 cam ranges due to modulo overflow in the win-
dow
 °°CamData0.LeftLimit1= 64626; °°°// 355° at load = 360° x 64626/65536
 °°CamData0.RightLimit1= 65536; °°°// 360° at load
 °°CamData0.LeftLimit2=  0;       // 0° at load
 CamData0.RightLimit2= 910;                // 5° at load
 CamData0.LeftLimit3=  31858;              // 175° at load
 CamData0.RightLimit3= 33678;              // 185° at load
 CamData0.LeftLimit4=  0;                  // not used
 CamData0.RightLimit4= 0;                  // not used
 _Go0( GO0_U_W_ZP );
 _GetSys( MyCamControl.CamControl ,GS_CAM );
 /*-------------------------------------
 Main program loop
 -------------------------------------*/
 while(1)
 {
 }
}
```

Example solved in the Assembler



477835787

7 Position Detection via Binary Inputs

7.1 Types of built-in encoders

For asynchronous AC motors, SEW-EURODRIVE offers a position detection with a simple incremental encoder (without position control). Those are built-in encoders.

The following table illustrates recommended encoders for the respective products:

Encoder	Unit		
	MOVIDRIVE® B	MOVITRAC® B	MQx module
EI7C		X	
EI76	X		X
EI72			
EI71			
ES16			X
NV26 (proximity sensor)			X

- You may also use a different encoder, but observe the following information:

INFORMATION

If the resolution is too high, the encoder might not be evaluated correctly at nominal speed.

- Select an encoder with a resolution that suits the pulse frequency of the inverter.
- Observe the technical data of the built-in encoders in "Drive Engineering, Practical Implementation – Encoder systems" and the technical data of the binary inputs (counter input).

7.2 Principle of the position detection

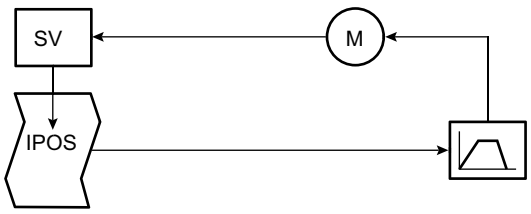
The track signals are transmitted to 2 binary inputs of your inverter and evaluated without encoder option. Index 8845 was implemented in order to activate the "Position detection".

Index 8845 has the following assignment:

- Position detection deactivated: 8845 = "0"
- Position detection activated: 8845 = "1"

You can set index 8845 in an IPOS$^{plus®}$ program with the MOVILINK command.

The following table illustrates the processing of the actual position in the IPOS$^{plus®}$ program:

Processing of the actual position in the IPOS$^{plus®}$ program	
 2211727115	• The actual position of the built-in encoder is mapped automatically in the IPOS$^{plus®}$ variable H511 and can be processed using program control. • The built-in encoder can be used in particular for applications in which positioning usually takes place using rapid speed/ creep speed by means of several proximity switches. • The encoder cannot be used for motor control (operating mode "…&n-control"). • The encoder cannot be used for direct position control (operating mode "…& IPOS"). • The "Simple Positioning" application module in MOVITOOLS® MotionStudio can be used for simple positioning tasks with MOVITRAC® B. SV = System variable IPOS = IPOS$^{plus®}$ program

7.3 Position detection with MOVIDRIVE® B

For MOVIDRIVE® B, SEW-EURODRIVE recommends the EI76 built-in encoder.

The binary inputs (counter inputs) of the MOVIDRIVE® B have the following technical data:

Binary inputs	
Encoder signals (2 tracks)	Track A and track B
Phase position	90° ± 20°
Mark space ratio	1:1 ±20%
Max. pulse frequency	350 Hz
Connection of track A	MOVIDRIVE® B: Terminal X13:3 (DI02)
Connection of track B	MOVIDRIVE® B: Terminal X13:4 (DI03)
Reference potential	DCOM

Simple positioning with MOVIDRIVE® B requires the inverter to be in one of the following operating modes:

- VFC (without feedback)
- V/f characteristic curve

	INFORMATION If MOVIDRIVE® B is equipped with an encoder option, it is not possible to evaluate the track signals of the binary inputs (counter inputs). • Use the MOVIDRIVE® B **without** encoder option.

Proceed as follows to use a built-in encoder:

1. Connect the encoder to the digital inputs of the MOVIDRIVE® B via terminals X13:3 (DI02) and X13:4 (DI03).
2. Set the following parameters (indexes):
   - *P601 binary inputs DI02* to "IPOS input" (Index 8336 to "16")
   - *P602 binary inputs DI03* to "IPOS input" (Index 8337 to "16")
3. Set index 8845 to "1" to activate the simple positioning.

The position is determined in the IPOS variable H511 (ActPos_Mot) and is always "0" when the line voltage is switched on.

A reference travel can only be performed by an IPOS$^{plus®}$ program.

7.4 Position detection with MOVITRAC® B

The binary inputs (counter inputs) of the MOVITRAC® B have the following technical data:

Binary inputs	
Encoder signals (2 tracks)	Track A and track B
Phase position	90° ± 20°
Mark space ratio	1:1 ±20%
Max. pulse frequency	120 kHz
Connection of track A	MOVITRAC® B: Terminal X12:5 (DI04)
Connection of track B	MOVITRAC® B: Terminal X12:4 (DI03)
Reference potential	GND to PE potential

For MOVITRAC® B, SEW-EURODRIVE recommends the EI7C built-in encoder.

Proceed as follows to use a built-in encoder:

1. Connect the encoder to the digital inputs of the MOVITRAC® B via terminals X12:5 (DI04) and X12:4 (DI03).
2. Set the following parameters (indexes):
   - *P602 binary input DI03* to "IPOS input" (Index 8338 to "16"),
   - *P603 binary input DI04* to "IPOS input" (Index 8339 to "16"),
3. Set index 8845 to "1" to activate the simple positioning.

The position is determined in the IPOS variable H511 (ActPos_Mot) and is always "0" when the line voltage is switched on.

A reference travel can only be performed by an IPOS$^{plus®}$ program.

	INFORMATION If you intend to use an application module for positioning, refer to the "MOVITRAC® B Simple Positioning Application Module" manual.

7.5 Position detection with MQx

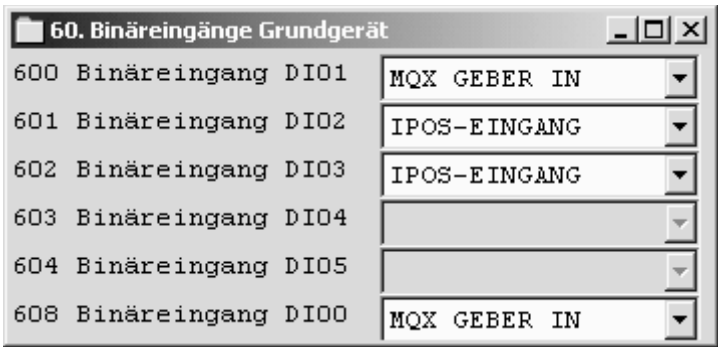
7.5.1 Proximity sensor evaluation

The MQx modules allow simple positioning based on the NV2 proximity sensor system. The two proximity sensors send 24 pieces of angle information per revolution. These are counted by MQx and stored in the IPOS$^{plus®}$ variable H511 (ActPos_Mot) as a positioning value. This allows the position to be processed in IPOS$^{plus®}$, which enables, for example, the drive to be stopped at a specified position. Creep speed must be used to reach the exact position. Position control is not available.

	INFORMATION Only one MOVIMOT® can be connected to the MQx fieldbus interface for proximity sensor evaluation. Only the Movcom command can be used to control the MOVIMOT®.

7.5.2 DI0 and DI1 terminal assignments

The proximity sensor evaluation is activated by setting the parameters for the two digital inputs DI0 and DI1 (P600 und P608) to "MQX ENCODER IN". The parameter settings can be changed using the MOVITOOLS® MotionStudio interface or in the initialization section of IPOS$^{plus®}$. IPOS$^{plus®}$ can address any MQx parameters at address 253 using the Movilink command. The indices of the inputs are 8844_{dec} for DI0 (P608) and 8335_{dec} for DI1 (P600). Two write accesses are used to transfer the value 32 to the two indices. The inputs are filtered according to the factory setting with 4 ms. The terminal assignment "MQX ENCODER IN" switches this filter for the proximity sensor evaluation off.



480483467

7.5.3 Position detection with built-in encoder

The binary inputs (counter inputs) of the MQx have the following technical data:

Binary inputs	
Encoder signals (2 tracks)	Track A and track B
Phase position	90° ± 20°
Mark space ratio	1:1 ±20%
Max. pulse frequency	4 kHz
Connection of track A	DI0
Connection of track B	DI1

For MQx, SEW-EURODRIVE recommends the EI76 built-in encoder.

Proceed as follows to use a built-in encoder:

1. Connect the encoder to the digital inputs of the MQx module. Use inputs DI0 and DI1.
2. Set the following parameters (indexes):
   - *P608 binary input DI03* to "MQX ENCODER IN" (Index 8844 to "32"),
   - *P600 binary input DI11* to "MQX ENCODER IN" (Index 8335 to "32"),

The position is determined in the IPOS variable H511 (ActPos_Mot) and is always "0" when the line voltage is switched on.

A reference travel can only be performed by an IPOS$^{plus®}$ program.

7.5.4 Encoder monitoring

The two encoder cables are checked for wire breaks. The cables are only monitored when MOVIMOT® is enabled. If a signal in at least one of the encoder cables does not change for 1 s, a wire break is detected and displayed by fault 14. MOVIMOT® stops and can only be started again when the MQx has been reset. During this process, the current position is lost and the system must be referenced again. Encoder monitoring can be switched on or off using parameter P504 (Encoder monitoring for motor).

7.5.5 Storing the actual position

When a MOVILINK command contacts address 253, the actual position can be stored at any time in a variable in the range H0 ... H127 in a non-volatile memory. We recommend you save the position each time the drive moves to a new actual position. This ensures that you do not have to perform reference travel when you restart the unit. Referencing is, however, still required if the MQx voltage is disconnected during a positioning operation. The module is designed to cope with 10 billion write cycles.

7.5.6 Counter

The MQx modules have a counter that can be connected to either DI0 or DI1. The positive edges are counted to a maximum input frequency of 4 kHz. You must change the setting of the corresponding input to "MQX ENCODER IN" to activate the counter function. This setting switches off the input filter automatically. As a result, the input signal for the counter must be fault-free and bounce-free. The value of the counter is written to variable H511.

	INFORMATION If both the inputs DI0 and DI1 are set to "MQX ENCODER IN", the proximity sensor evaluation is activated automatically and the counter function is switched off.

7.5.7 Connecting the built-in encoders

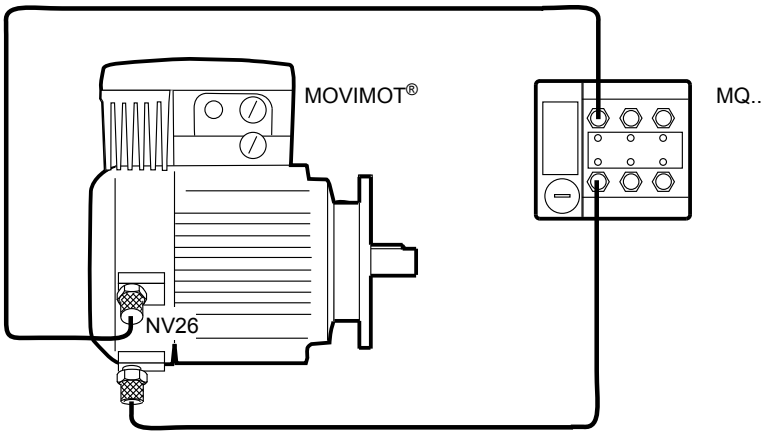
The cabling of the built-in encoders can be checked using the LEDs of the MQx. When a motor turns slowly, the LEDs at inputs DI0 and DI1 flash.

Connecting the NV26 proximity sensor

To connect the NV26 built-in encoders (proximity sensors), refer to the "Drive System for Decentralized Installation – PROFIBUS Interfaces, Field Distributors" manual.

Two simple 4-pole, shielded sensor cables with plug and M12 socket are required for connection. The cable connects the NV26 proximity sensors to DI0 and DI1 of the bus module.

We recommend you use metal M12 plug and sockets and connect the shielding at both ends.



480466315

If the MQx interface counts the motor position in H511 in the wrong direction, the M12 plugs at inputs DI0 and DI1 must be exchanged.

Connecting the EI76, ES16 incremental encoder

To connect the EI76 and ES16 built-in encoders, refer to the "Drive System for Decentralized Installation – PROFIBUS Interfaces, Field Distributors" manual.

8 IPOS$^{plus®}$ and Fieldbus

8.1 Introduction

Cyclical process data and acyclical parameters are exchanged between a PLC and input/output signal stations via fieldbus, SBus or RS-485.

For information on the supported communication interfaces, refer to the respective system manual.

For a more detailed description of the communication interfaces, refer to the "Communication and Fieldbus Unit Profile" manual and the manuals for the individual fieldbuses. To control the MOVIDRIVE® unit via fieldbus, you usually have to change the following parameters:

- P100 Setpoint source = e.g fieldbus, if setpoints are to be sent via fieldbus
- P101 Control signal source = fieldbus, if control words are to be sent via fieldbus
- P870-875 process data configuration: Specifies the data to be exchanged via the bus

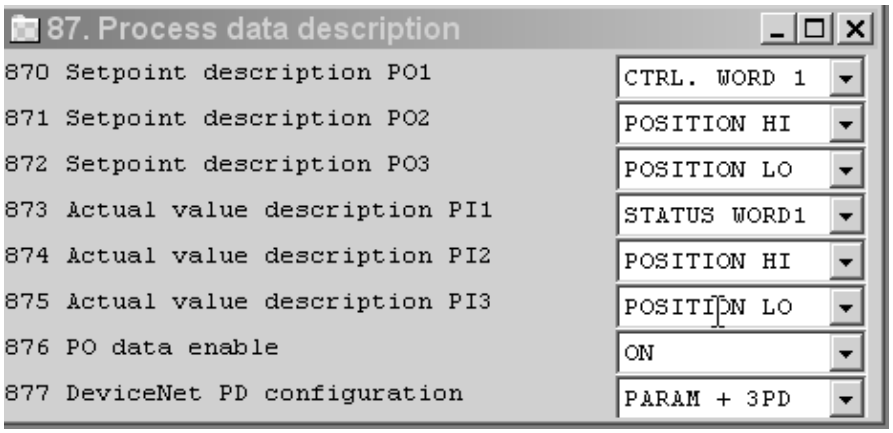
The IPOS$^{plus®}$ program code is generally the same for fieldbuses; that is, it is identical for INTERBUS and PROFIBUS.

A number of program examples displaying the connection between IPOS$^{plus®}$ and the fieldbus are included in the "Communication and Fieldbus Unit Profile" manual.

Parameters P870 ... P877 can be used to set up to 3 process data words in both directions without an IPOS$^{plus®}$ program. Depending on the fieldbus it might be possible to exchange more process data words.

All words as of the 4th word are assigned the designation IPOS$^{plus®}$ PI DATA or IPOS$^{plus®}$ PO DATA Process data assigned these designations are not interpreted directly by the inverter. However, all process data can be accessed via the data structures of the GETSYS or SETSYS command.

Process data assignment with 3 words:



477958795

8.2 Binary inputs and outputs

If neither a DIO nor DIP is inserted in MOVIDRIVE®, the bits in control word 2 / status word 2 can be addressed in the IPOS$^{plus®}$ program as follows:

- Directly with the symbolic names DI10 ... DI17 or DO10 ... DO17
- Read indirectly with GETSYS and written with SETSYS

In this case, they can be described as binary inputs and outputs simulated via virtual terminals. The meaning of the terminals can be set via parameters P610 ... P617 or P630...P637.

8.2.1 Fieldbus interface, DIO and DIP

If a DIO or DIP is inserted in MOVIDRIVE®, the organization of the terminal assignment moves as described for the affected system variables (see below), and the process data can only be accessed via GETSYS and SETSYS:

Unit	Outputs	Inputs
MOVIDRIVE® A	H481 StdOutpIPOS H480 OptOutpIPOS H482 OutpLevel (read only)	H483 InpLevel
MOVIDRIVE® B	H481 StdOutpIPOS H480 OptOutpIPOS H521 OutpLevel (read only)	H520 InpLevel

8.3 Cyclical process data

Cyclical process data is read and written in a time slice of 5 ms.

8.3.1 Cyclical preset process data

If a value, for example, SPEED is set in the parameters P870 ... P875, the process data item is linked directly with an internal value.

The drive receives a double word as a position setpoint. MOVIDRIVE® copies this value to variable H499 SetpPosBus and, if P916 ramp type is set to BUSRAMP, it automatically uses this value as the position setpoint. If P916 Ramp type = LINEAR, SINE, SQUARED or JERK LIMITED, the setpoint can be further processed in the user program or copied directly to a target position H492 TargetPos or H454 ModTagPos using one of the following commands.

- TargetPos = SetpPosBus; (Compiler)
- SET H492 = H499 (Assembler)

INFORMATION

The double word with the actual position value that is sent from the drive to the PLC in the example is always the position from H509 ... H511 of the encoder selected in P941 Source actual position.

8.3.2 Cyclical user-specific process data

Users have the option of choosing the description of the cyclical process data themselves. To do so, assign the parameter setting PO data for the output data or PI data for the input data in the process data configuration. In this case, process output data is not evaluated directly by MOVIDRIVE® but must be copied to the IPOS$^{plus®}$ variables using the commands GETSYS (PO data) or SETSYS (PI data). The variables are decoded in the IPOS$^{plus®}$ program. In this way, the user can, for example, transfer position setpoints in user units (for example, motor revolutions) by multiplying or dividing the value transmitted by the fieldbus before it is used for positioning.

Example

Six process data items with user-specific description should be transferred (P870-877 = IPOS PI-DATA or IPOS PO_DATA). At output word 2, 3, the PLC transfers the position setpoint to the drive, at input word 3, the drive sends the drives sends the actual position in modulo format 1/10° (0.0° ... 360.0).

Compiler

```
#include <const.h>
// Process data data structures
GSPODATA10 tPA;           //Output data (PLC -> Drive)
SSPIDATA10 tPE;           //Input data (Drive -> PLC)
/*============================================
Main function (IPOS initial function)
============================================*/
main()
{
 /*-------------------------------------
 Initialization
 -------------------------------------*/
   // Initialize fieldbus variables for Getsys and Setsys commands
 tPA.BusType = GS_BT_FBUS;
 //Process data operation via fieldbus interface see above
 tPA.Len = tPE.Len = 6; //PD length 6 words
 /*-------------------------------------
 Main program loop
 -------------------------------------*/
 while(1)
 {
      // Import PO data
  _GetSys( tPA, GS_PODATA );
      // Copy double word 2,3 to modulo target position
      ModTagPos = (tPA.PO3 & 0xFFFF) + (tPA.PO2 & 0xFFFF)<<16; //PO2,PO3
  // .....
      //Regenerate process input data and send to PLC
      tPE.PI3 = 3600* ModActPos/ 65536; //Actual position in 1/10 degree
at word 3
  _SetSys( SS_PIDATA, tPE );  //Send PD
     } //End while (1)
} // Ende main============================================================
```

Assembler

```
        SET H320  = 3
        SET H332  = 6
        SET H321  = 6
M1  :GETSYS  H320 = PO-DATA
        SET H300  = H324
       AND H300  & FFFF     hex
       SET H301  = H323
       AND H301  & FFFF     hex
       ADD H300  + H301
       SHL H300  << 16
       SET H354  = H300
       SET H300  = 3600
       MUL H300  * H355
       DIV H300  / 65536
       SET H335  = H300
       SETSYS PI-DATA         = H332
       JMP UNCONDITIONED  , M1
```

8.4 Acyclical communication

For each fieldbus, MOVIDRIVE® supports the option to read and write all parameters, variables, cam disks and the IPOS$^{plus®}$ program via acyclical communication (also referred to as parameter channel or parameter service). An IPOS$^{plus®}$ program or parameter settings are not required.

Data in the inverter is accessed via index addressing. For the index of a parameter, refer to the parameter list or press CTRL-F1 in the input field of the parameter.

The index of a H-variable is the number of the variable plus 11000 (for example, H34 has the index 11034).

With MOVIDRIVE® B, for example, a parameter service is processed in a 5-ms time slice.

8.5 Special features of communication via SBus

If you use the SBus instead of a fieldbus as the data source for control and setpoint values, the same functionality is available as for the fieldbus, but cyclical process data is read or written in a time slice of 1 ms.

Furthermore, it is possible to receive or send additional cyclical or acyclical messages via an SBus with an IPOS$^{plus®}$ program. For more information, see MOVILINK and SCOM in the sections "Compiler Functions" and "Assembler Commands".

8.6 Special features of communication via RS-485

With MOVIDRIVE® and MOVITRAC® B, due to the low transmission speed, you should limit the use of the RS-485 interface to acyclical (parameter) communication.

8.7 Fieldbus control words and fieldbus status words

For detailed information regarding the control and status word, refer to section "SEW unit profile" in the "Communication and fieldbus unit profile" manual.

9 IPOSplus® and Synchronized Motion

9.1 Introduction

MOVIDRIVE® and MOVITRAC® B allow for master-slave operation.

Further, you can synchronize several MOVIDRIVE® units more exactly, for example, for applications with the following functions:

- Mechanical axes run by several drives (for example, gantries, multiple column hoists). Note: For more project planning information in this case, refer to the "MOVIDIRVE® – Multi-Motor Drives" manual).
- Speed or position of a slave axis is derived from the position of a master axis (electronic shaft, electronic cam).

MOVIDRIVE® offers preconfigured hardware and software functions for both applications that can be activated by the IPOSplus® user program. These are described in the following sections.

9.2 Speed synchronization via master/slave function

Via parameters P750 and P751, you can activate a simple speed synchronization for MOVIDRIVE® and MOVITRAC® B without an IPOSplus® program or a technology unit.

A typical application example is the synchronized operation of 2 conveyor belts. For more information, refer to the system manual.

9.3 Synchronous operation with a DRS option card

	INFORMATION An IPOSplus® program is not required to use the synchronous operation card DRS11.

The DRS11 synchronous operation card allows for multiple axes to be operated at a synchronous angle in relation to one another or with an adjustable proportional relationship (electronic gear). The system differentiates between master and slave drives. The master drive, used for positioning one or more slave drives, can also be an incremental encoder. The slave drive(s) follow(s) the specified master positions.

The basis for synchronous operation is the continual comparison between master and slave positions. The system determines the difference of the route information between master and slave and stores this value in the form of incremental encoder signals in an internal difference counter that cannot be accessed by the user. Binary signals, such as "DRS SLAVE IN POS", "DRS LAG ERROR", "DRS PREWARNING" and "MASTER STANDSTILL" are set depending on the basis of this difference. This counter is evaluated depending on the operating mode. In synchronous operation, the internal difference counter is used to correct any angular offset between the slave and master to 0.

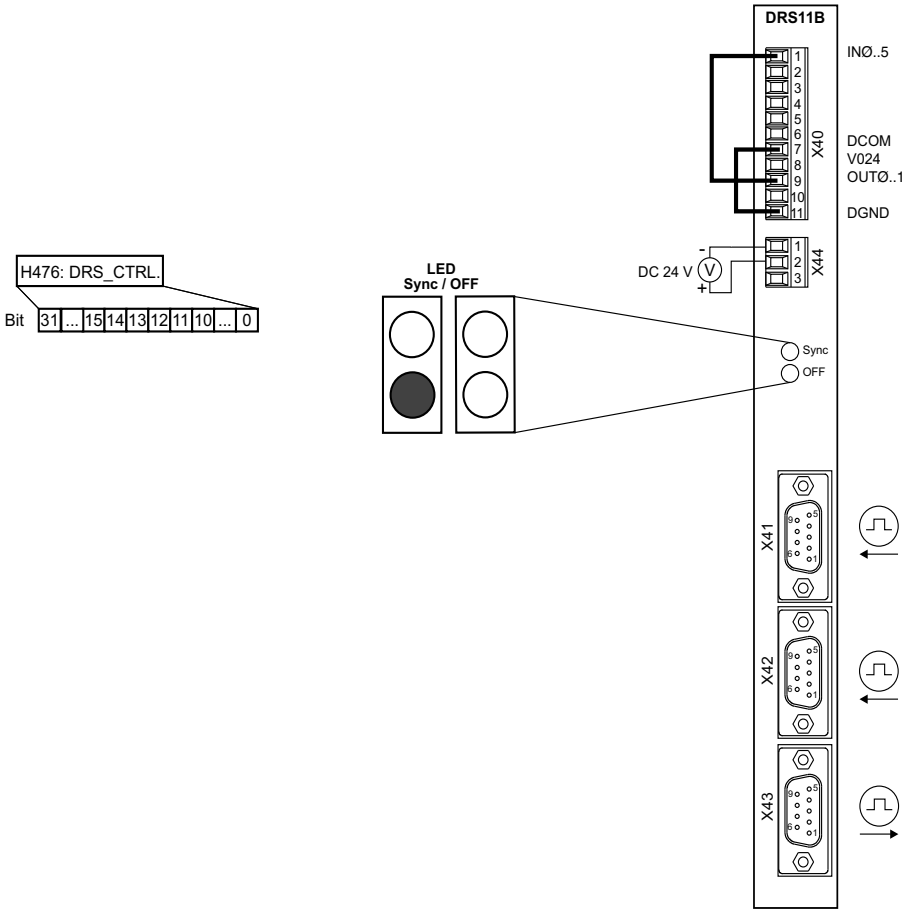
DRS is controlled using the variables H473, H476, H477 and H484 (see section "Overview of system variables"). The following section describes how the DRS can be addressed from the IPOSplus® program.

For more detailed information, refer to the "DRS11 Synchronous Operation Card" manual.

9.3.1 Activating and deactivating the free running function

The system variable H476 DRS CTRL can be used to set and reset the two programmable outputs of DRS11.

Free running function:



478829067

Requirement

DRS11 can be switched to the free running mode using IPOS$^{plus®}$ via a cable connected from terminal X40:9 (OUTP0) to X40:1 (free mode)

Command sequence in Assembler

Set OUTP0 and thus DRS input "Free-running": in free-running mode, the red LED on the DRS card is lit.

```
BSET H476.0 = 1
```

Switch back to the synchronous operation function: The red LED does not light up in synchronous operation mode.

```
BCLR H476.0 = 0
```

Write to BCLR H476.0.

Command sequence in the Compiler

```
_BitSet( 476, 0 );
_BitClear( 476, 0 );
```

9.3.2 Setting the zero pointfor DRS11B

The angular offset of DRS11 can be reset using IPOS$^{plus®}$ without an external signal.

The H484 CTRL. WORD system variable is used for this process.

The process of resetting the angular offset between the master and slave can be monitored in the status LED of the DRS card.

Red = free running

Green = DRS not in position (angular offset is greater than P514)

Command sequence in Assembler

```
BSET H484.22 = 1       Set DRS11 to "Set zero point"
WAIT 15 ms       DRS-specific waiting time of 15 ms
BCLR H484.22 = 0       Reset function 'Set zero point'
```

Command sequence in the Compiler

```
_BitSet( 484,22 );
_Wait( 15 );
_BitClear( 484,22 );
```

Control example

- The drive should be switched to **Free running** using input **DI10**. Inputs DI10 ... DI17 can be either physical terminals on DIO11A and DIP11A or virtual terminals in fieldbus control word 2.
  - DI10 = 1 Free running activated
  - DI10 = 0 Free running mode deactivated; drive runs in synchronous operation
- The current angular offset is deleted via input **DI11** (DRS **Set zero point**).

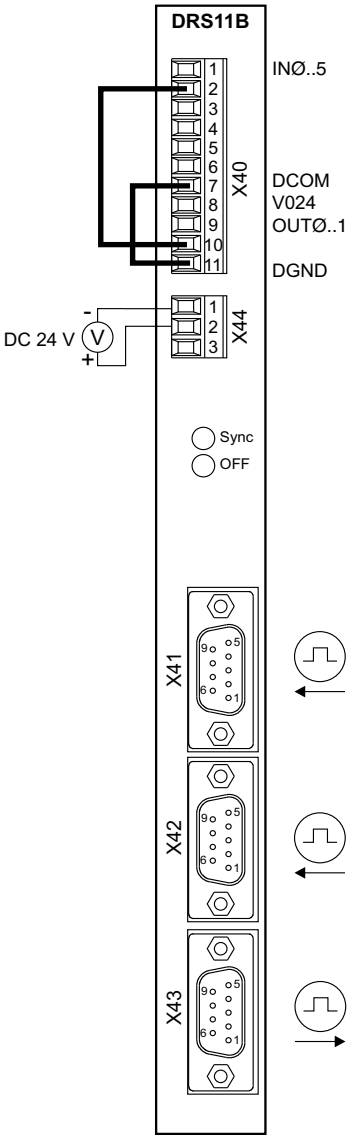
Sample program with IPOS$^{plus®}$ Compiler

```
/*====================================================================
IPOS source file
====================================================================*/
#include <const.h>
#include <io.h>
/*----- Define inputs ---------------------------------------*/
#define E_Free running         DI10 // Input DI10
#define E_Set zero point  DI11 // Input DI11
/*----- Define outputs --------------------------------------*/
#define A_DRS_OUTP0 0 // Output DRS X40:9
/*----- Define control bits in IPOS control word ---------------*/
#define _DRS_Set zero point 22 // Bit 22
*====================================================================
Subprograms
====================================================================*/
Free running_On()
{
 /* Free running is activated over the external jumper between X40:9 and X40:0
by setting the output X40:9. */
 _BitSet( DRS_Ctrl, A_DRS_OUTP0 );
}
/*====================================================================*/
Free running_Off()
{
 /* Free running is deactivated over the external jumper between X40:9 and X40:0
by deleting the output X40:9. */
 _BitSet( DRS_Ctrl, A_DRS_OUTP0 );
}
/*====================================================================*/
DRS_Zero point()
{
 _BitSet( ControlWord, _DRS_SetZeroPoint );
 // Set zero point via control word
 _Wait( 15 ); // Response time in ms
 _BitClear( ControlWord, _DRS_Set zero point ); // Delete bit
}
/*====================================================================
Main function (IPOS initial function)
====================================================================*/
main()
{
 if( E_Free running )  // E_FreeRunning input (here DI10)
    Free running_On();             // Switches between
   else                         // Free running and synchronous operation
  °°Free running_Off();

 if( E_Set zero point )     // The function "Set zero point"
    DRS_zero point();            // is called
}
```

9.3.3 Activating and deactivating the offset function

Via the system variable DRS CTRL. H476 you can set/reset the two programmable outputs of the DRS11.

Offset wiring example:



478833419

Output X40:10 is set using the BSET H476.1 command. A signal is sent to X40:2 via a jumper from X40:10 to X40:2, and the "Offset" function is activated.

Requirement

A position offset can be applied using IPOS$^{plus®}$ via a cable connection from terminal X40:10 to X40:2 (Offset1).

Command sequence in Assembler

Set the drive to the function "Offset1": Slave drive changes its position in relation to the master to the value stored in offset1.

```
BSET H476.1 = 1
```

Switch back to output terminal: The slave drive moves back to the previous position in relation to the master.

```
BCLR H476.1 = 0
```

Write to BCLR H476.0.

Command sequence in the Compiler

```
_BitSet( 476, 1 );
_BitClear( 476, 1 );
```

9.3.4 Switching between positioning and synchronous operation

The "Free running" function makes it possible for the drives to run separately at a controlled speed. However, when this function is activated, the drive cannot move to a specified position using position control.

To perform this function, the operating mode Positioning (IPOS$^{plus®}$) is required.

In the following sample program, the system can switch between the operating modes Synchronous operation and Positioning via input terminal DI12.

In this context, note the following condition:

	INFORMATION **The system can only change from synchronous operation to positioning in the operating modes CFC or SERVO when the drive is in operation.** For the VFC operating modes, MOVIDRIVE® must be in the status Controller inhibit.

The following sample program looks at a switchover between the operating modes CFC & IPOS and CFC & SYNC with SETSYS.

The following settings apply (terminal function via the IPOS$^{plus®}$ program determines the parameter settings for all used inputs at the IPOS input):

- DI10 = 0 no free-running
- DI10 = 1 Free running, if operating mode CFC & SYNC is set
- DI11 = 0 no function
- DI11 = 1 Set DRS zero point (pulse)
- DI12 = 1 Positioning, operating mode CFC & IPOS
- DI12 = 0 Synchronous operation, operating mode CFC & SYNC

The operating modes can be changed using the command

```
_SetSys(SS_OPMODE, H)
```

In which the value of the H variable has the following meaning:

SS_OPMODE: Sets the operating mode
H = 11: Operating mode CFC (speed control)
H = 12: Operating mode CFC & torque control
H = 13: Operating mode CFC & IPOS (positioning)
H = 14: Operating mode CFC & synchronous running (DRS11A)
H = 16: Operating mode SERVO (speed control)
H = 17: Operating mode SERVO & torque control
H = 18: Operating mode SERVO & IPOS (positioning)
H = 19: Operating mode SERVO & synchronous running (DRS11A)

```
/*====================================================================
IPOS source file
====================================================================*/
#include <const.h>
#include <io.h>
/*----- Define inputs -------------------------------------*/
#define E_Free running         DI10 // Input DI10
#define E_Set zero point  DI11 // Input DI11
#define E_Switch_Pos_Sync  DI12 // Input to switch between
// Positioning and synchronous operation
// DI 12 = 1 Positioning /
// DI 12 = 0 Synchronous operation
/*----- Define outputs ------------------------------------*/
#define A_DRS_OUTP0 0 // Output DRS X40:9
/*----- Define control bits in IPOS control word ---------------*/
#define _Free running 1     // Bit  1
#define _DRS_Set zero point 22 // Bit 22
/*----- Define variables to switch between
/*----- Positioning and synchronous operation ---*/
#define operating mode           H300
#define target position          H0
#define CFC_and_IPOS          13     // Operating mode CFC & IPOS
#define CFC_and_SYNC 14     // Operating mode CFC & synchronous operation
/*====================================================================
Subprograms
====================================================================*/
Free running_On()
{
 /* Free running is activated over the external jumper between X40:9 and X40:0
by setting the output X40:9. */
 _BitSet( DRS_Ctrl, A_DRS_OUTP0 );
}
/*====================================================================*/
Free running_Off()
{
 /* Free running is deactivated over the external jumper between X40:9 and X40:0
by deleting the output X40:9. */
 _BitSet( DRS_Ctrl, A_DRS_OUTP0 );
}
/*====================================================================*/
DRS_Zero point()
{
 _BitSet( ControlWord, _DRS_SetZeroPoint );
 // Set zero point via control word
 _Wait( 15 ); // Response time in ms
 _BitClear( ControlWord, _DRS_Set zero point ); // Delete bit
}
/*====================================================================*/
Activate_synchronous operation()
{
 Operating mode = CFC_and_SYNC;
 _SetSys( SS_OPMODE,operating mode ); // Switch operating mode
 DRS_zero point(); Delete quadrantal error
}
/*====================================================================*/
Activate_IPOS()
{
 Operating mode = CFC_and_IPOS;
 _SetSys( SS_OPMODE,operating mode );
}
```

```
/*====================================================================
Main function (IPOS initial function)
====================================================================*/
main()
{
   if( E_Free running )
  °°Free running_On();
 else
  °°Free running_Off();
   if( E_Set zero point )
  °°DRS_Zero point();
   if( E_Switch_Pos_Sync )
 {
      Activate_IPOS();
      _GoAbs( GO_NOWAIT,target position );
 }
   else if( !E_Free running )
      Activate_synchronous operation();
}
```

9.4 Synchronous operation with technology option "Internal synchronous operation"

Internal synchronous operation is a firmware solution used to operate several axes at synchronous angles. This software solution simply requires pulses from a master unit. This master source can either be the X14 input (physical master drive) or any IPOS$^{plus®}$ variable (virtual master drive) (e.g. in conjunction with the SBus or a virtual encoder). As of the MOVIDRIVE® B series, any source can be selected for the actual position of the axis (absolute encoder, synchronous encoder or any IPOS$^{plus®}$ variable).

In this way, axes with slip can also be synchronized using internal synchronous operation. For MOVIDRIVE® A, only the motor encoder can be used as the actual source position.

Synchronous operation comprises various functions. One of the functions is that the drive can be positioned according to a specified offset and startup cycle. An offset between the master and slave drive comes into effect after a specified number of master increments.

The synchronization mechanism (time-controlled synchronization process), as seen with the DRS11 synchronous operation card, is also implemented. A variation between the angle of the slave drive and the master drive resulting from free running is reduced to zero.

Synchronization can also be position-controlled. The slave drive moves at a synchronous angle to the master drive following a specified number of master increments (startup cycle process). In this type of startup, the slave drive moves with a quadratic ramp.

9.4.1 Requirements

Synchronous operation has been designed for MOVIDRIVE® and places the following requirements on the drive system:

- Encoder feedback
- DRS option cards not supported
- Operating mode: not V/f

- IPOS$^{plus®}$ variables H360 to H450 are reserved for synchronous operation and should not be used in the application program see section "Overview of System Variables (page 29)".
- Synchronous operation is controlled using IPOS$^{plus®}$ variables within an IPOS$^{plus®}$ program. All states of synchronous operation can be viewed and set in the variable range for synchronous operation from H360 to H450.
- ISYNC startup is supported by a graphical user interface.
- Slave is not subject to slip (only with MOVIDRIVE® A).

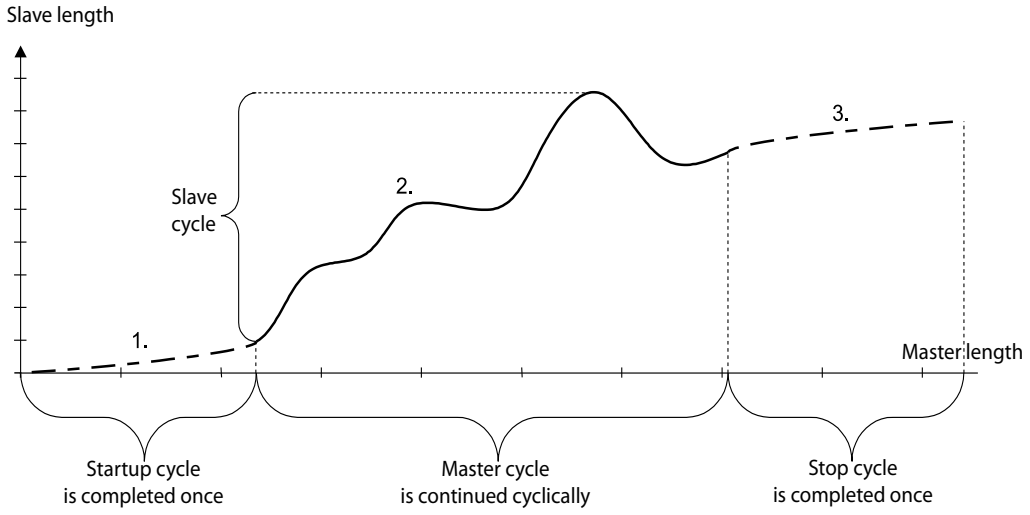
For more detailed information, refer to the "Internal Synchronous Operation (ISYNC)" manual.

9.5 Synchronous operation with technology option "Cam"

A master movement is usually represented as a machine angle between 0 and 360 degrees. A number of curve points are defined with reference to this machine angle (the "Movement plan"). These control points specify the position of the particular slave drive with reference to the master.

The master drive can either be a physical drive or a virtual master encoder. The master encoder can also be switched over using the synchronized system bus (SBus). The relationship between the positions of the master drive and the slave drive is often specified in a 2-dimensional graph. The position of the master drive is entered along the horizontal axis and the position of the slave drive along the vertical axis. The range of positions along the horizontal axis is referred to as the master cycle, the range of positions along the vertical axis as the slave cycle.

Electronic cam:



478837771

[1] Startup cycle is run through once
[2] Master cycle is repeated cyclically
[3] Stop cycle is run through once
[4] Slave cycle
s1 Master length
s2 Slave length

9.5.1 Requirements

The electronic cam option places the following requirements on the drive system:

- Encoder feedback
- Operating mode: "CFC" or "Servo" ... & IPOS
- IPOS$^{plus®}$ variables H360 to H450 are reserved for synchronous operation and should not be used in the application program (see section 3.2 "Overview of System Variables").
- Synchronous operation is controlled using IPOS$^{plus®}$ variables within an IPOS$^{plus®}$ program. All states of the electronic cam can be viewed and set in the variable range for synchronous operation from H370 to H450.

For more detailed information, refer to the Addendum to the "Electronic Cam" system manual.

	INFORMATION If the movement plan contains a constant incline, phase-synchronous operation occurs as a special case in the electronic cam.

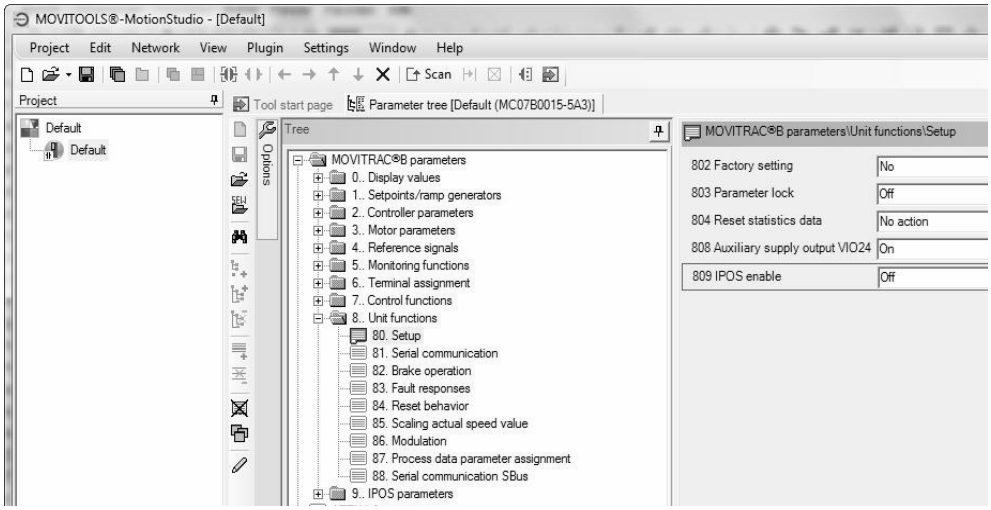
10 IPOS$^{plus®}$ for MOVITRAC® B – Characteristics

10.1 Requirements

Units from the MOVITRAC® B series can be ordered as standard units or as technology units. Unlike MOVIDRIVE® B, the standard unit must first be enabled for IPOS$^{plus®}$ before you can start programming.

Enabling IPOS $^{plus®}$ in the standard unit:

1. Open parameter tree
2. In the 'Unit functions/setup' parameter group, set 'IPOS enable' to ON.



769774603

Now you can program IPOS$^{plus®}$ as usual using Compiler or Assembler.

	In the technology unit, IPOS$^{plus®}$ is enabled as standard.

10.2 Functionality

In general, MOVITRAC® B IPOS$^{plus®}$ has the same functions as MOVIDRIVE® B in VFC operating mode.

In addition there are the following restrictions:

- Restrictions regarding the range of commands with MOVIDRIVE® B
- The size of the IPOS program memory is 8kB, which is only 50% of the MOVIDRIVE® B IPOS$^{plus®}$ program memory of 16 kB.
- Task 3 must not be used. The program code programmed in task 3 is not executed. No feedback is given on this.
- Unsupported functions cause error 10 IPOS ILLOP.

	The IPOS Compiler is not aware of these differences, i.e. the complete MOVIDRIVE® B functionality is provided.

Refer to the following sections for a detailed description of the differences:

- Overview of commands for standard functions (page 205)
- Technical data (page 25) for MOVITRAC® B
- Position detection (page 98) with MOVITRAC® B

11 IPOS$^{plus®}$ for MQx – Characteristics

11.1 Introduction

In the same way as for MFx modules, modules of the MQx series allow a cost-effective fieldbus interface to MOVIMOT® drives. In addition, the MQx modules are equipped with control functions that help you determine how the drive responds to external input via fieldbus and integrated I/Os.

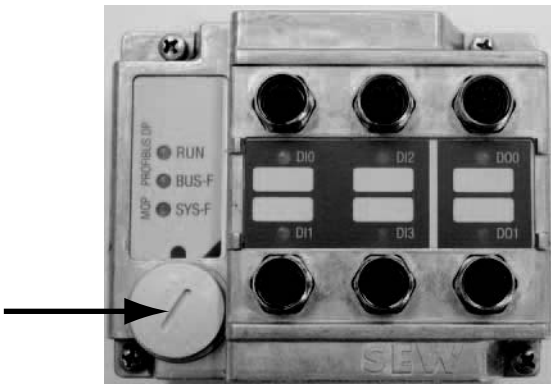
This allows, for example, sensor signals to be processed directly at the fieldbus interface or allows users to define their own communication profile via the fieldbus interface. The NV26 proximity sensor provides you with a simple positioning system that can be integrated in systems in conjunction with an MQx control program as standard components. In principle, the same IPOS$^{plus®}$ program as used in MOVIDRIVE® A runs in the MQx interface. However, full functionality cannot be realized in some cases. The following section describes these differences.

- The parameter group P900 IPOS$^{plus®}$ parameters is not implemented for the MQx interface.
- As with MOVIDRIVE® A, the MQx fieldbus interface provides two tasks with the same command processing times for IPOS$^{plus®}$ commands.
- When using the IPOS$^{plus®}$ variable H511 (ActPos_Mot), the NV26 encoder does not count 4096 inc./revolution but 24 inc./revolution.
- Not all IPOS$^{plus®}$ commands can be used.

11.2 Starting the programming tool

You can access the fieldbus interface via the diagnostics and programming interface (under the screw plug on the front) of the MQx modules.

- Connect the serial interface of your PC with the programming interface of the MQx. Use the UWS21A. option.



480461579

- Start the required programming interface via MOVITOOLS® MotionStudio.

  Refer to section: "Step 1: starting IPOSplus® Compiler with MOVITOOLS® MotionStudio (page 143)"

11.3 Sequence control system

The following section lists all the IPOSplus® functions that can be used in the MQx. A more detailed description of the commands can be found in the sections Compiler Functions and Assembler Commands. For any additional information, refer to the online help of the programming tool selected. There are no limitations compared to MOVIDRIVE® A for loops and operators.

The fieldbus process data buffer can be accessed via the commands _GetSys and _SetSys. The RS-485 interface for MOVIMOT® can be influenced via the _MovComm commands.

11.4 Digital inputs and outputs

The DO0 and DO1 digital outputs of MQx (not available for MQx32) can be switched on and off using the H481 StdOutpIPOS variable. To do so, the parameters P620 (DO1) and P628 (DO0) must be set to IPOS Output.

H481

...	3	2	1	0
			DO1	DO0

The MQx digital inputs can be read using the H483 InputLevel variable. DI4 and DI5 are only available with MQx32. To be able to use the inputs as IPOSplus® inputs, you must set them to IPOSplus® Input in parameter group 62.

H483

...	5	4	3	2	1	0
	(DI5)	(DI4)	DI3	DI2	DI1	DI0

11.5 Values of the DIAG11 variable for the error IPOS ILLOP

An IPOS ILLOP error is generated as a general error message when an error occurs in the IPOS$^{plus®}$ program.

An internal error number is sent to the diagnostic variable H469 (DIAG11) for detailed error analysis. Every error that can occur is assigned its own error number. 999 means that the function or an argument of the function is not supported by the MQx module.

The following error numbers can occur when using the MOVLNK and MOVCOM commands.

DIAG11	Command	Cause of error
500	MOVLNK	MOVLNK command was called after cyclical communication was started. MOVLINK is locked by the _MovCommOn command.
501	MOVLNK	Number of variable H, from where the read data is stored or from where the data to be written is obtained, does not lie in the valid range (H0 ... H450).
502	MOVLNK	Bus type is invalid. Only 2 = RS-485#2 permitted.
503	MOVLNK	An invalid PDU type was entered in format. Only acyclical frames (128 ... 134) are permitted.
504	MOVCOM	_MovCommDef command was called after cyclical communication was started. _MovCommDef is locked by MovComOn.
505	MOVCOM	_MovCommDef command was called for the 9th time. Only 8 communication relations are permitted.
506	MOVCOM	Bus type is invalid. Only 2 = RS-485#2 permitted.
507	MOVCOM	An invalid station address has been entered. Addresses 253 and 254 are not permitted (0 -252, 255).
508	MOVCOM	An invalid PDU type was entered in format. Only cyclical frames are permitted (0-6).
509	MOVCOM	Number of variable H, from where the read data is stored or from where the data to be written is obtained, does not lie in the valid range (H0 ... H450).
511	MOVCOM	Station does not support the PDU type entered in format.

12 P9xx IPOS Parameters

⚠ DANGER

Risk of crushing if the motor starts up unintentionally.

Severe or fatal injuries.

- Ensure that the motor cannot start unintentionally.
- Note that modifying these parameters without knowledge of the IPOS$^{plus®}$ program, which may be active, can cause unexpected movements and place unwanted loads on the mechanical driveline. It is essential that you are familiar with the IPOS$^{plus®}$ manual to make the setting for these parameters.

12.1 P90x IPOS reference travel

Reference travel is used to establish a **machine zero** to which all absolute positioning commands refer. It is possible to select from various strategies, referred to as reference travel strategies P903 Reference travel type (page 124). These strategies define appropriate travel modes, for example to search for a reference cam. Using the **reference point** determined by reference travel, the machine zero point can be changed using P900 Reference offset (page 123) according to the following equation:

Machine zero = reference position + reference offset

The speeds of the travel movements required on the basis of the **reference travel type** are set using P901 Reference speed 1 (page 124) and P902 Reference speed 2 (page 124).

Display range: Number of increments between leaving the reference cam and reaching the zero pulse of the encoder set in P941.

The value is displayed after the reference travel. Ideally, it should be half the encoder resolution (after quadruple evaluation). Relocate the cam if necessary.

12.1.1 P900 Reference offset

Setting range: $-(2^{31}-1) - \underline{0} - 2^{31}-1$

Reference offset (zero offset) is used to determine the machine zero (origin). The following applies:

Machine zero = reference position + reference offset

The reference offset always refers to the encoder set via P941 Source actual position (page 134).

This encoder can be a motor encoder, an external encoder or a DIP encoder. The corresponding actual positions are indicated by IPOS$^{plus®}$ variables.

- H509 Actual position DIP encoder
- H510 Actual position external encoder
- H511 Actual position motor encoder

Reference offset becomes active after reference travel has been completed successfully.

	INFORMATION
	In case of a reference travel of a drive system with absolute encoder (HIPERFACE® or DIP), P905 Hiperface offset X15 (page 126) / P947 Hiperface offset X14 (page 136) or DIP offset P953 Position offset (page 139) will be recalculated and overwritten by the reference travel depending on the actual position source.

12.1.2 P901 Reference speed 1

Setting range: 0 – 200 – 6000 rpm

Reference speed 1 determines the travel speed for the first part of the reference travel. Speed change always takes place via stop ramp t13. The search directions during reference travel are determined by the respective reference travel type. The speed is in effect until the reference cam has been reached.

12.1.3 P902 Reference speed 2

Setting range: 0 – 50 – 6000 rpm

Reference speed 2 determines the travel speed for the second part of the reference travel. Speed change always takes place via stop ramp t13. The search directions during reference travel are determined by the respective reference travel type. The speed is effective upon leaving the reference cam until reaching the first zero pulse.

12.1.4 P903 Reference travel type

Setting range: 0 – 8

The reference travel type specifies the reference travel strategy that is used to establish the machine zero of a machine.

This setting also defines the search direction for the reference cam in the individual referencing phases.

Use parameter P904 Referencing to zero pulse (page 126) to determine if the reference travel takes place to the edge change of the reference cam or the next zero pulse of the encoder.

Prerequisite for execution of reference travel is a drive that is **ready** and **enabled** with the exception of reference travel type 8.

There are also types available that can function without a reference cam.

- **Type 0: CCW zero pulse**
  - First search direction is CCW.
  - Reference position = Left zero pulse from current position
  - Machine zero = reference position + reference offset
- **Type 1: CW end of the reference cam**
  - First search direction is CCW.
  - Reference position = First zero pulse or falling edge to the left of the reference cam
  - Machine zero = reference position + reference offset
- **Type 2: CW end of the reference cam**

  - First search direction is CW.
  - Reference position = First zero pulse or falling edge to the right of the reference cam
  - Machine zero = reference position + reference offset
- **Type 3: CW limit switch**
  - First search direction is CW.
  - Reference position = First zero pulse or falling edge to the left of the right limit switch.
  - Machine zero = reference position + reference offset
  - Reference travel should take place to zero pulse.
- **Type 4: CCW limit switch**
  - First search direction is CCW.
  - Reference position = First zero pulse or falling edge to the right of the left limit switch.
  - Machine zero = reference position + reference offset
  - Reference travel should take place to zero pulse.
- **Type 5: No reference travel**
  - Reference position = current position
  - Machine zero = reference offset
- **Type 6: Reference cam flush with CW limit switch**
  - First search direction is CW.
  - Reference position = First zero pulse or falling edge to the left of the reference cam
  - Machine zero = reference position + reference offset
  - Note: Reference cam and limit switches must be flush!
- **Type 7: Reference cam flush with CCW limit switch**
  - First search direction is CCW.
  - Reference position = First zero pulse or falling edge to the right of the reference cam
  - Machine zero = reference position + reference offset
  - Note: Reference cam and limit switches must be flush!
- **Type 8: Without enable**

  Reference travel can take place when the drive is not enabled.
  - Reference position = current position
  - Machine zero = reference offset

12.1.5 P904 Reference travel to zero pulse

Setting range: YES/NO

- YES: Reference travel takes place to the zero pulse of the selected IPOS$^{plus®}$ encoder.
- NO: Reference travel takes place to the falling edge of the reference cam.

12.1.6 P905 Hiperface offset X15

Setting range: $-(2^{31} - 1) - 0 - 2^{31} - 1$

This parameter is used to specify the zero point of the motor encoder display.

Use this parameter to define the machine zero without reference travel. It adds or subtracts the offset from the encoder value.

- P905 Hiperface offset X15 (page 126) has an effect on the actual position of the motor encoder H511.

  H511 = Encoder value – P905
- P947 Hiperface offset X14 (page 136) affects the actual position of the external encoder H510.

  H510 = Encoder value – P947

The actual position is determined directly after the values have been entered. A Hiperface® multi-turn encoder must be referenced once, a Hiperface® single-turn encoder must always be referenced.

Note:

When reference travel of a drive system takes place with a Hiperface® encoder, the Hiperface offsets (P905 or P947) are recalculated and overwritten due to the reference travel depending on the set actual position source.

The following applies:

- P905 = Encoder value – P900
- P947 = Encoder value – P900

12.1.7 P906 Cam distance

Parameter *P906* is a display parameter.

It shows the number of increments between leaving the reference cam and reaching the zero pulse of the encoder set in *P941*. Ideally, the value should be half the encoder resolution (after quadruple evaluation). Relocate cam if necessary.

The value is displayed after the reference travel.

12.2 P91x IPOS^plus® parameters

12.2.1 P910 Gain X controller

Setting range: 0,1 – 0,5 – 32

Setting value for the P controller of the position control loop in IPOS^plus®. The value from P210 P gain hold controller is adopted here in the default setting.

12.2.2 P911/912 Positioning ramp 1/2

Setting range: 0,01 – 1 – 20 s

Value set for the ramp used during the positioning operation. The same ramp (positioning ramp 1) is always used for acceleration and deceleration when the ramp type setting is P916 Ramp function (page 128) SINE and SQUARED. With LINEAR ramp function, deceleration will be set depending on P917 Ramp mode (page 130):

- P917 Ramp mode = Mode 1: Deceleration for travel to target position (spot braking) only takes place with positioning ramp 2 (P912). Positioning ramp 1 (P911) is used for all other positioning operations.
- P917 Ramp mode = Mode 2: Positioning ramp 2 (P912) is used for deceleration of the travel speed during travel. Positioning ramp 1 (P911) is used for acceleration.

12.2.3 P913/P914 Travel speed CW/CCW

Setting range: 0 – 1500 – 6000 rpm

Specifies the speed used for positioning. The setting must be adjusted to the maximum motor speed.

	INFORMATION
	P302 Maximum speed 1 / P312 Maximum speed 2 limits P913/P914; set P302 Maximum speed 1 / P312 Maximum speed 2 to a value (ca. 10%) greater than P913/P914 to prevent lag errors

12.2.4 P915 Velocity precontrol

Setting range: –199,99 – 0 – 100 – 199,99%

When the setting is 100%, the drive moves at an optimum speed with a linear speed profile. If a value less than 100% is specified, a larger gap between position setpoint and actual position occurs (lag distance) during a positioning operation. This results in a "soft" run-in to the target position for the acceleration procedure.

	INFORMATION
	Parameter P915 is only in effect with the LINEAR and JERK LIMITED ramp types. The function has no effect for the ramp types "SINE" and "SQUARED".

12.2.5 P916 Ramp type

This parameter specifies the type of the positioning ramp. This influences the speed or acceleration characteristics during positioning.

INFORMATION

The following ramp types are not supported if P702 Motor category is set to "Linear":

- SPEED INTERPOLATION
- POSITION INTERPOLATION 12 BIT
- POSITION INTERPOLATION 16 BIT

Ramp type	Positioning characteristics
LINEAR	Time-optimal but block-shaped acceleration profile.
SQUARED	Softer acceleration and higher torque demand than LINEAR.
SINE	Very soft acceleration profile, required torque higher than with SQUARED acceleration profile.
BUS RAMP	Setting for operation of drive inverter with master controller. This controller generates a cyclical position setpoint that is written directly to the position controller. The ramp generator is deactivated. The position specifications sent cyclically by the external controller are interpolated linearly. For configuration, one process output data word must be set to "position HIGH" and another one to "position LOW".
JERK LIMITED	Jerk limitation is based on the principle of the linear ramp. For jerk limitation, the torque and, therefore, the acceleration is trapezoidal to limit the jolting action. Over time, jerk limitation builds up the torque in linear form during acceleration until the maximum value is reached. In the same way, the torque is reduced again over time in linear form to zero. This means that system vibrations can be virtually avoided. A setting range can be selected from 0.005 ms to 2 ms (P933). The positioning time in comparison to the linear ramp is extended by the set jerk time. The acceleration and torque do not increase in comparison with the linear ramp.
ELECTRONIC CAM	Activating the technology function "Electronic cam".
I SYNCHRONOUS OPERATION	Activating the technology function "Electronic cam".
CROSS CUTTER	Activating the technology function "Cross cutter".
SPEED INTERPOLATION	The speed values sent cyclically by the external controller are interpolated linearly. • Speed specification via process data: – Set P888 *Synchronization time SBus* to 5 ms or 10 ms – Set the *P100 Setpoint source* to "SBus" or "Fieldbus" – You have to set a process output data word to "Speed". • Speed specification via SBus/SCOM object: – Set *P888 Synchronization time SBus* to 1 ... 10 ms. – Set the *P100 Setpoint source* to "BIPOL. FIXED SETPT". – You must not set a process output data word to "Speed". – Create a SCOM receive object (using the SCOM receive command → IPOS$^{plus®}$ manual) with the target variable *SetpPosBus* (H499).

Ramp type	Positioning characteristics
POSITION INTERPOLATION 12 BIT	The position specifications sent cyclically by the external controller are interpolated. Position resolution: 1 revolution corresponds to 4096 increments (12 bit). • Position specification using process data: – Set P888 *Synchronization time SBus* to 5 ms or 10 ms – Set *P100 Setpoint source* to "SBus" or "Fieldbus" – Set one process output data word to "position HIGH" and another one to "position LOW". • Position specification via SBus/SCOM object: – Set *P888 Synchronization time SBus* to 1 ... 10 ms. – Set *P100 Setpoint source* to "BIPOL. FIXED SETPT". – Do not set a process output data word to "position HIGH" or "position LOW". – Create a SCOM receive object (using the SCOM receive command → IPOS$^{plus®}$ manual) with the target variable *SetpPosBus* (H499).
POSITION INTERPOLATION 16 BIT	The position specifications sent cyclically by the external controller are interpolated. Position resolution: 1 revolution corresponds to 65536 increments (16 bit). • Position specification using process data: – Set P888 *Synchronization time SBus* to 5 ms or 10 ms – Set *P100 Setpoint source* to "SBus" or "Fieldbus" – Set one process output data word to "position HIGH" and another one to "position LOW". **Important:** Position resolution via PI data assignment is 4096 increments per revolution (= 12 bit). IPOS$^{plus®}$ variable H508 provides the motor position, extended to 16 bits. The IPOS$^{plus®}$ variable *ActPos_Mot* (H511) has a position resolution of 4096 increments per revolution (= 12 bit) • Position specification via SBus/SCOM object: – Set *P888 Synchronization time SBus* to 1 ... 10 ms. – Set *P100 Setpoint source* to "BIPOL. FIXED SETPT". – Do not set a process output data word to "position HIGH" or "position LOW". – Create a SCOM receive object (using the SCOM receive command → IPOS$^{plus®}$ manual) with the target variable *SetPosBus* (H499). **Important:** Position resolution via PI data assignment is 4096 increments per revolution (= 12 bit). The position resolution of 4096 increments per revolution (= 12 bit) expanded to 16 bit is available on IPOS$^{plus®}$ variable H508. The IPOS$^{plus®}$ variable *ActPos_Mot* (H511) has a position resolution of 4096 increments per revolution (= 12 bit)

INFORMATION

Note the following for the POSITION "INTERPOLATION 16 BIT" ramp type:

- IPOS variable H508 is also used when S14 is set to ON.
  IPOS variable H508 only provides meaningful values when
  – DIP switch S14 = "ON" **or**
  – P916 Ramp type = "Position interpolation 16 bit"

12.2.6 P917 Ramp mode

Setting range: MODE 1/MODE 2

This parameter determines the use of P912 Positioning ramp 2 with ramp type set to LINEAR.

- P917 = MODE 1: Deceleration for travel to target position (spot braking) takes place with P912 Positioning ramp 2. P911 positioning ramp 1 is used for all other positioning operations. If position interpolation 12 bit or 16 bit is active, it runs in mode 1 without dead time compensation.
- P917 = MODE 2: Positioning ramp 2 is always used for deceleration if the travel speed is changed during travel. P911 positioning ramp 1 is used for acceleration. If position interpolation 12 bit or 16 bit is active, mode 2 activates a dead time compensation.

12.2.7 P918 Bus setpoint source

In conjunction with EtherCAT, this parameter can be used to set the source for the setpoint in IPOS$^{plus®}$. The preset value is H499.

12.3 P92x IPOS monitoring

12.3.1 P920/P921 SW limit switch CW/CCW

Setting range: $-(2^{31}-1) - \underline{0} - 2^{31}-1$

The software limit switches let the user limit the range in which travel commands are accepted. This is implemented via software. The limits of the movement range are specified using these two parameters (software limit switches). If *P941 Source actual position* is set to motor encoder or external encoder, then these do not take effect until after performance of a reference travel. If (page 134) is set to absolute encoder DIP, then these are effective immediately without reference travel. If the software limit switches are in effect, the system checks whether the target position H492 of the current travel command is beyond the software limit switches. If the target position is beyond the range limited by the limit switches, the travel command will not be executed. The drive responds according to the fault response set in P838. If *P838 error response SW limit switch* is set to "../warning" or ".../fault", then error message "A1.F78" (IPOS SW limit switch) is generated. The software limit switches are only monitored in the "...& IPOS" (P700) operating modes.

If *P838 Fault response SW limit switch* is set to ".../Fault", then a drive with incremental encoder is no longer referenced after a fault reset whereas a drive with absolute encoder is still referenced.

If the drive is not referenced, the software limit switches have no effect. They are only activated again after the drive has been referenced.

If *P838 Fault response SW limit switch* is set to ".../Warning", the drive remains referenced following a reset. The drive can move past the target specified due to the mass moment of inertia of the machine or if the parameter settings are set incorrectly in the controller. Software limit switches cannot prevent this from happening.

Deactivation: Set both parameter values to 0 for endless travel so that the software limit switch function is deactivated.

12.3.2 P922 Position window

Setting range: 0 – <u>50</u> – 32 767 Inc

The parameter defines a distance range (position window) around the target position of a travel or STOP command. The "Axis in position" = YES condition applies if a drive is inside the position window around the current target position (H492). The "Axis in position" information is used as a final condition for waiting positioning commands. It can be used further as an output terminal function.

12.3.3 P923 Lag error window

Setting range: $0 - \underline{5000} - 2^{31}-1$ Inc

The lag error window defines a permitted difference between the setpoint and actual position value. If the permitted value is exceeded, a lag error message or lag error response will be triggered. You can set the responses with P834 Response to lag error.

Deactivation: Set value = 0 deactivates lag error monitoring

12.3.4 P924 Positioning interruption detection

Setting range: ON/<u>OFF</u>

This parameter determines whether the positioning process is monitored for interruptions (enable signal revoked). The response is set in *P839 Response to "Positioning interruption*.

12.4 P93x IPOS$^{plus®}$ special functions

12.4.1 P930 Override

Setting range: ON/OFF

The override function makes it possible to change the travel speed for positioning operations which is programmed in the IPOS$^{plus®}$ program. The speed can be altered within the range from 0 to 150% of the specifically programmed speed. This requires an analog input, with 0 to 150% corresponding to 0 – 10 V at the analog input. The maximum speed value is limited by P302 Maximum speed 1 / P312 Maximum speed 2.

12.4.2 P931 IPOS CTRL.W Task 1

Setting range: STOP / START / HALT

IPOS CTRL.W Task 1 in the DBG60B keypad only, not in SHELL.

STOP: Task 1 of the IPOS$^{plus®}$ program is stopped.

START: Task 1 of the IPOS$^{plus®}$ program is started.

STOP: Tasks 1, 2 and 3 of the IPOS$^{plus®}$ program are stopped.

12.4.3 P932 IPOS CTRL.W Task 2

Display range: START/STOP

IPOS CTRL.W Task 2 in the DBG60B keypad only, not in SHELL.

Display parameter, cannot be set using DBG60B.

START = Task 2 of the IPOS$^{plus®}$ program is currently being processed.

STOP = Task 2 of the IPOS$^{plus®}$ program is stopped.

12.4.4 P933 Jerk time

Setting range: 0.005 – 2 s

The jerk time indicates the duration of the torque formation. The positioning time in comparison to the linear ramp is extended by the set jerk time.

The jerk time (0.005 ... 2 s) that has to be set for the function jerk limit. Please note that P911 Positioning ramp 1 (page 127) / P912Positioning ramp 2 (page 127) are of a greater or equal value.

P933 ≤ P911 & P912

If P933 > P911 & P912, torque formation still has a trapezoidal shape with the set jerk time not being the time for the torque formation.

12.4.5 P938 Speed task 1

Setting range: 0 – 9 additional Assembler commands/ms

The standard setting for task 1 is 1 Assembler command/ms. The speed can be increased by up to 9 additional Assembler commands/ms with P938. P938 and P939 share the resources for the speed increase; that is, task 1 and task 2 **together** can be assigned a total of 9 additional Assembler commands/ms. Example:

Task 1 **+ 2 additional Assembler commands/ms** = 3 Assembler commands/ms

Task 2 **+ 7 additional Assembler commands/ms** = 9 Assembler commands/ms

12.4.6 P939 Speed task 2

Setting range: 0 – 9 additional Assembler commands/ms

The standard setting for task 2 is 2 Assembler commands/ms. The speed can be increased by up to 9 additional Assembler commands/ms with P939. P938 and P939 share the resources for the speed increase; that is, task 1 and task 2 **together** can be assigned a total of 9 additional Assembler commands/ms. Example:

Task 1 **+ 2 additional Assembler commands/ms** = 3 Assembler commands/ms

Task 2 **+ 7 additional Assembler commands/ms** = 9 Assembler commands/ms

12.5 P94x IPOS$^{plus®}$ encoder

12.5.1 P940 IPOS variable edit

Setting range: ON/OFF

IPOS$^{plus®}$ variables edit with DBG60B keypad only, not in SHELL.

IPOS$^{plus®}$ variables can be changed if P940 is set to "ON".

12.5.2 P941 Actual position source

Setting range: Motor encoder (X15) / Ext. Encoder (X14) absolute encoder (X62)

Defines the encoder to which IPOS$^{plus®}$ positions.

12.5.3 P942/P943 Encoder factor numerator/denominator

Setting range: 1 – 32767

First set the parameter P944 encoder scaling ext. encoder (page 135) orP955 encoder scaling (page 139) (when using DIP11B or DEH21B option). Next, set P942/P943.

In the event of positioning to an external encoder (X14) or an absolute encoder (X62), then these two parameters are used for adapting the resolution to the motor encoder (X15).

Proceed as follows:

- Write down the values of variables H509 absolute position (H510 with external encoder) and H511 Current motor position.
- Move the drive by about 30,000 increments (H511).
- Calculate the difference between the values you wrote down and the new values of the variables:
  - H509 new – H509 old = H509 difference
  - H511 new – H511 old = H511 difference
- The values must not differ by more than 32 767 (2^{15} –1). If the values are greater, divide both differentials by the same number to obtain correspondingly smaller values. Alternatively, repeat the procedure with a shorter travel distance.
- Enter the result H511 difference in P942 Encoder factor nominator and H509 in P943 Encoder factor denominator.

12.5.4 P944 Encoder scaling ext. encoder

Setting range: x1 / x2 / x4 / x8 / x16 / x32 / x64

Before setting P944, make sure that P942 and P943 are set to "1".

The significance of the travel resolution of the motor encoder and external encoder is adapted. The parameter is set so the travel information ratio between the motor encoder and the external encoder is as close to "1" as possible. First set the parameter to "x1". To do this, note the values in variables H510 and H511.

- Move the drive by about 1000 increments (H511).
- Calculate the difference between the values you wrote down and the current values:
  - H510 new – H510 old = H510 difference
  - H511 new – H511 old = H511 difference
- Calculate the quotient from H511 difference divided by H510 difference. Set the parameter P944 Encoder scaling ext. to the value that is closest to the calculated quotient.

.

Important: The encoder scaling directly affects the parameters P900 reference offset (page 123), P942 encoder factor numerator (page 134) and P943 encoder factor denominator (page 134) as well as the parameter group P92x IPOS monitoring. All positions of the IPOS$^{plus®}$ program have to be adjusted when using the external encoder. The setting of all listed parameters has to be adjusted every time the encoder scaling is changed.

The number of pulses detected at X14 is multiplied by P944 and then mapped to H510. The external encoder must always provide fewer pulses than the motor encoder. If this is not possible, contact SEW-EURODRIVE.

12.5.5 P945 Synchronous encoder type (X14)

Setting range: TTL / SIN/COS / HIPERFACE

Enter the used encoder type here. Possible encoder types are:

- TTL: Encoder with digital, rectangular output signal (TTL level 0 V, 5 V, with negated tracks, encoder with signal level according to RS422
- SIN/COS: Encoder with analog, sine-shaped output signal (1 V_{SS})
- HIPERFACE®: Encoder with designation AV1H, AS1H, ES1H, EV1H

SEW encoder type	Startup parameters encoder type / encoder PPR count
ES1S / ES2S / EV1S / EH1S	SINE ENCODER / 1024
AV1Y	SINE ENCODER / 512
ES1R / ES2R / EV1R / EH1R	INCREM. ENCODER TTL / 1024
ES1T[1] / ES2T[1] /EV1T[1] /EH1T[1]	INCREM. ENCODER TTL / 1024
AV1H / AS1H / ES1H / EV1H	HIPERFACE®

1) via DWI11A only

12.5.6 P945 Synchronous encoder counting direction (X14)

Setting range: NORMAL/INVERTED

Defines the counting direction of the synchronous encoder. The setting must be made so the counting direction of the motor encoder (X15) and the synchronous encoder (X14) match.

12.5.7 P947 Hiperface offset X14

Setting range: $-(2^{31} - 1) - 0 - 2^{31} - 1$

This parameter is used to specify the zero point of the motor encoder display.

Use this parameter to define the machine zero without reference travel. It adds or subtracts the offset from the encoder value.

- P905 Hiperface offset X15 (page 126) has an effect on the actual position of the motor encoder H511.

  H511 = Encoder value – P905

- P947 Hiperface offset X14 (page 136) affects the actual position of the external encoder H510.

  H510 = Encoder value – P947

The actual position is determined directly after the values have been entered. It does not require prior reference travel.

Note:

When reference travel of a drive system takes place with a Hiperface® encoder, the Hiperface® offsets (P905 or P947) are recalculated and overwritten due to the reference travel depending on the set actual position source.

The following applies:

- P905 = Encoder value – P900
- P947 = Encoder value – P900

12.5.8 P948 Automatic encoder replacement detection

Setting range: ON/OFF

This parameter is only effective with Hiperface® encoders.

- ON: A replaced Hiperface® encoder is detected. Reference travel is required before the "IPOS referenced" bit is set.

  Note the following when operating a linear motor with AL1H motor encoder:

  If the linear motor was commutated in the dialog "Encoder adjustment" during initial startup, the "LSM commutated" bit will be cleared in the IPOS status word after encoder replacement. A new commutation travel must be triggered to enable the inverter. Doing so will reset the "LSM commutated" bit. Commutation travel is triggered automatically if the "/CONTROLLER INHIBIT" terminal is set to "1" and no terminal set to "Enable" receives a "1 signal". If a terminal set to "Enable" receives a "1 signal", or if no terminal is set to "Enable", error message F81 will be issued.

  For linear motors with AL1H motor encoder, SEW-EURODRIVE recommends to set parameter P948 to "OFF". After having replaced the encoder, test the drive system with reduced velocity and force in jog mode.

- OFF: The Hiperface® encoder is always referenced. The "IPOS referenced" bit is set.

  Note the following when operating a linear motor with AL1H motor encoder:

  If the linear motor was commutated in the dialog "Encoder adjustment" during initial startup, the "LSM commutated" bit will be maintained in the IPOS status word. The drive system can be enabled immediately.

	INFORMATION
	If P948 is switched off and on again, the "IPOS referenced" bit is set to "0" once you have restarted the MOVIDRIVE®. Reference travel is necessary to rest the "IPOS referenced" bit to "1".

12.6 P95x absolute encoder (SSI)

The DIP parameters are described in detail in the "MOVIDRIVE® MDX61B Absolute Encoder Card DIP11B/DEH21B" manual. The DIP11B option cannot be used with MOVIDRIVE® MDX61B size 0.

12.6.1 P950 Encoder type

The absolute encoder connected to the DEH21B/DIP11B option (X62) is selected. At present, encoders can be selected from the following list:

- VISOLUX EDM
- T&R CE65, CE58, CE100 MSSI
- T&R LE100, LE200
- T&R LA66K
- AV1Y/ROQ424
- STEGMANN AG100 MSSI
- SICK DME -3000-111
- STAHL WCS2-LS311
- STEGMANN AG626
- IVO GM401, GXMMW A202PA2
- STAHL WCS3
- LEUZE OMS1, OMS2
- T&R ZE 65M
- LEUZE BPS37
- SICK DME 5000-111
- POMUX KH53
- KÜBLER 9081
- LEUZE AMS200
- MTS TEMPOSONICS RP
- P+F AVM58X-1212
- Hübner HMG161 S24 H2048
- Balluf BTL5-S112B-M1500
- T&R LA41K
- Elgo LIMAX2

12.6.2 P951 Counting direction

Setting range: NORMAL/INVERTED

Defines the counting direction of the absolute encoder. The setting must be made so the counting direction of the motor encoder (X15) and the absolute encoder (X62) match.

12.6.3 P952 Cycle frequency

Setting range: 1 – 200%

Defines the cycle frequency at which absolute encoder information is transmitted from the encoder to the inverter. A cycle frequency of 100% corresponds to the nominal frequency of the encoder in relation to a 100 m cable length.

12.6.4 P953 Position offset

Setting range: $-(2^{31}-1)$ – 0 – $2^{31}-1$

The position offset P953 only needs to be set on incremental encoders; it should be set to 0 for other encoders.

Note: The position value will be recalculated and overwritten automatically after successful completion of the reference travel.

12.6.5 P954 Zero offset

Setting range: $-(2^{31}-1)$ – 0 – $2^{31}-1$

Zero offset is used for assigning the value you want to a specific position. The range of values can adopt positive or negative position values. The maximum valid parameter must not be exceeded. The limit is determined by the range of values of the numerator (2^{31}) and the range of values of the absolute encoder. Move the drive to a known position. Read off the value of variable H509 ACT.POS.ABS and enter the following value in parameter P954 Zero offset: P954 = Variable H509 – required value.

The required value is the display value you wish to have for the current position.

12.6.6 P955 Encoder scaling

Setting range: x1 / x2 / x4 / x8 / x16 / x32 / x64

Before setting P955, make sure that P942 and P943 are set to "1".

The significance of the travel resolution of the motor encoder and absolute encoder is adapted. The parameter is set so the travel information ratio between the motor encoder and the absolute encoder is as close to "1" as possible. First set the parameter to "x1". To do this, note the values in variables H509 and H511.

- Move the drive by about 1000 increments (H511).
- Calculate the difference between the values you wrote down and the current values:
  - H509 new – H509 old = H509 difference
  - H511 new – H511 old = H511 difference
- Calculate the quotient from H511 difference divided by H509 difference. Set parameter P955 Encoder scaling to the value that is closest to the calculated quotient.

Important: Encoder scaling directly affects parameters P900 Reference offset (page 123), P942 Encoder factor numerator (page 134), P943 Encoder factor denominator (page 134), P954 Zero offset (page 139) as well as the parameter group P92x IPOS monitoring (page 131). All positions of the IPOS$^{plus®}$ program have to be adjusted when using the external encoder. The setting of all listed parameters has to be adjusted every time the encoder scaling is changed.

12.6.7 P956 CAN encoder baud rate

Setting range: 125 kbaud / 250 kbaud / 500 kbaud / 1 Mbaud

Sets the baud rate of the connected CAN encoder.

12.7 P96x IPOS$^{plus®}$ modulo function

The IPOS$^{plus®}$ modulo function is used for endless positioning, for example with circular indexing tables or chain conveyors. Refer to the IPOS$^{plus®}$ manual for detailed information.

12.7.1 P960 Modulo function

Setting range: OFF / SHORT / CW / CCW

- OFF: The modulo function is deactivated.
- SHORT: The "short travel" modulo function is active. The drive moves from the actual position to the target position taking the shortest possible route. Both directions of rotation are possible.
- CW: The "CW" modulo function is active. The drives moves from its actual position to the target position with a "CW" direction of rotation, even if this means moving a longer distance. The "CCW" direction of rotation is not possible.
- CCW: The "CCW" modulo function is active. The drives moves from its actual position to the target position with a "CCW" direction of rotation, even if this means moving a longer distance. The "CW" direction of rotation is not possible.

12.7.2 P961 Modulo numerator

Setting range: $0 – 1 – 2^{31} – 1$

Simulation of the gear unit by entering the number of teeth of the gear unit and the additional gear.

Modulo numerator = Numerator gear unit i x numerator additional gear i

12.7.3 P962 Modulo denominator

Setting range: $0 – 1 – 2^{31} – 1$

Simulation of the gear unit by entering the number of teeth of the gear unit and the additional gear.

Modulo denominator = Denominator gear unit i x denominator additional gear i

12.7.4 P963 Modulo encoder resolution

Setting range: 0 – 4096 – 65535

Resolution of the selected IPOS$^{plus®}$ encoder system in increments.

The IPOS$^{plus®}$ encoder resolution for positioning to the motor encoder will be set to 4,096 increments (prerequisite is an encoder resolution of 512 to 2,048).

12.8 P97x IPOS synchronization

12.8.1 P970 DPRAM synchronization

Setting range: ON/OFF

MOVIDRIVE® B allows for synchronized operation with option cards (e.g. DHP11B, DFE24B).

ON: Synchronized operation with option card is activated.

Important: The inverters may either be synchronized by SBus1, SBus2 or by DPRAM. The inverters must **not be synchronized from several interfaces at the same time**. SEW-EURODRIVE recommends to set P885/P895 to an identifier that is not used in the entire CAN network. You need parameters P888 and P916 to implement synchronization with interpolating setpoint processing.

OFF: Synchronized operation with the option card is not activated.

12.8.2 P971 Synchronization phase

Setting range: −2 – 0 – 2 ms

Time interval between clock signal and data transfer

13 Compiler – Editor

13.1 Technical features

- Integrated IPOS$^{plus®}$ positioning and sequence control. IPOS$^{plus®}$ units do not required any additional hardware.
- Program creation in a high-level language
- Symbolic variable names
- Option of writing program modules that can be used again in other projects
- Clear, modular and structured programming
- Various loop techniques
- Compiler control using preprocessor commands
- Standard structures
- User-defined structures
- Access to all system variables
- Standard functions
- Debugger for troubleshooting
- Extensive options for making comments
- Integrated in the Windows interface
- Integrated in the MOVITOOLS® MotionStudio software package

13.2 First steps

This description is intended to help you familiarize yourself with the programming of the IPOS$^{plus®}$ Compiler as quickly as possible. You are given an introduction into the basic functions of the Compiler by means of an example which is created and developed step-by-step from one chapter to the next.

This introduction is based on the assumption that you are familiar with a conventional Windows operating system and standard Office applications.

The introduction comprises the following 4 steps:

Step 1: Starting IPOS$^{plus®}$ Compiler with MOVITOOLS® MotionStudio

This section illustrates the basic steps for starting the IPOS$^{plus®}$ Compiler via MOVITOOLS® MotionStudio.

Step 2: Creating a new project

This section illustrates the IPOS$^{plus®}$ Compiler user interface provides information on how to create a new IPOS$^{plus®}$ project.

Step 3: The first IPOS$^{plus®}$ program

This section is to assist you in creating your first IPOS$^{plus®}$ program.

Step 4: Compiling and starting the IPOS$^{plus®}$ program

In this chapter, you will compile the program you created in step 3, load it into MOVIDRIVE® and run the program.

13.2.1 Step 1: Starting IPOS$^{plus®}$ Compiler with MOVITOOLS® MotionStudio

Requirements

The IPOS$^{plus®}$ Compiler is integrated in the MOVITOOLS® MotionStudio software package.

The following conditions have to be fulfilled before you can start the IPOS$^{plus®}$ Compiler via MOVITOOLS® MotionStudio:

- MOVITOOLS® MotionStudio 5.40 or later is installed on your PC.
- The device you want to create an IPOS$^{plus®}$ program for is connected to your PC. Use a suitable interface adapter.

MOVITOOLS® MotionStudio and creating a project

Proceed as follows to start MOVITOOLS® MotionStudio and create a project:

1. Start the MOVITOOLS® MotionStudio from the Windows start menu via:
   [Start]/[Programs]/[SEW]/[MOVITOOLS-MotionStudio]/[MOVITOOLS-MotionStudio]
2. Create a project with a name and directory.

Establishing communication and scanning the network

Proceed as follows to establish a communication with MOVITOOLS® MotionStudio and scan your network:

1. Set up a communication channel (e.g. "serial") to communicate with your units.

   For a detailed description on how to configure a communication channel, refer to the MOVITOOLS® MotionStudio documentation (manual or online help).

2. Scan your network (unit scan). Press the [Start network scan] button [1] in the toolbar.

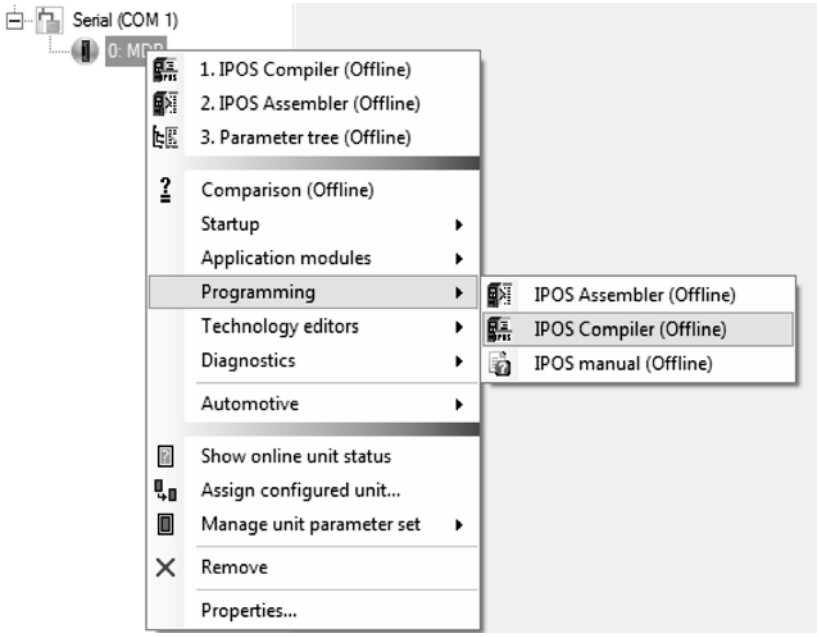
1132720523

Starting IPOS$^{plus®}$ Compiler

Proceed as follows to start the IPOS$^{plus®}$ Compiler via MOVITOOLS® MotionStudio:

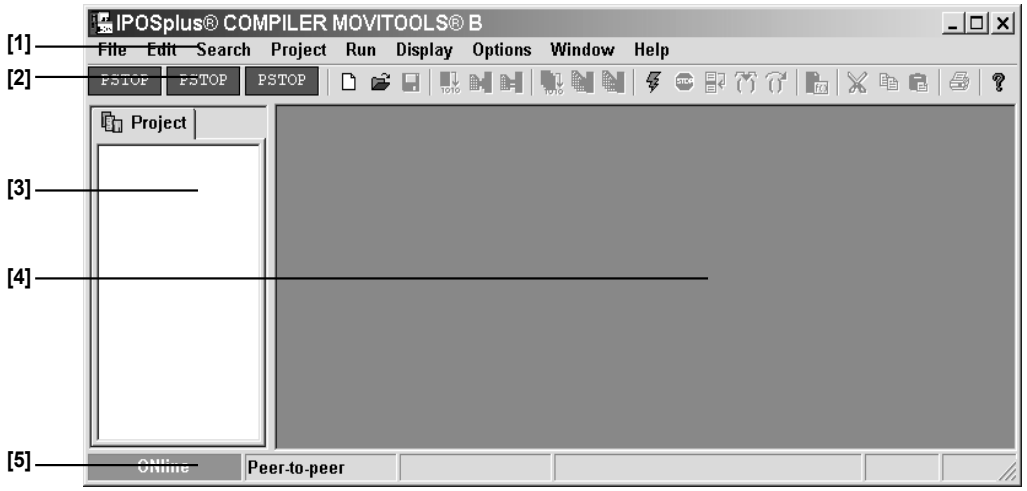
1. Mark the device you want to start the IPOS$^{plus®}$ Compiler for.
2. Right-click to open the context menu.
3. Start the IPOS$^{plus®}$ Compiler via the following menu item:

   [Programming] / [IPOS Compiler] /



2123686283

The IPOS$^{plus®}$ programming interface opens:

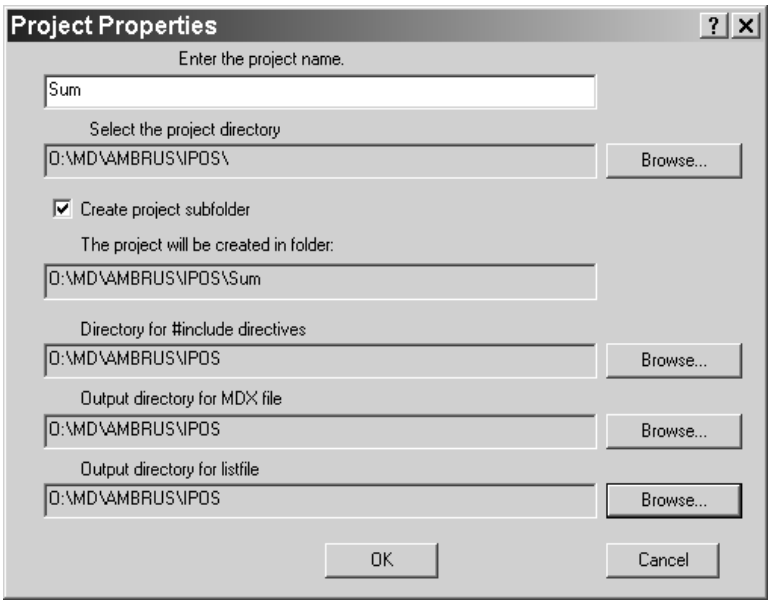


482065675

[1] Menu bar
[2] Toolbar
[3] Project window
[4] Program window
[5] Status bar

13.2.2 Step 2: Creating a new project

To create a new project, choose [Project]/[Create new...] from the menu bar. Use the following dialog window to specify the basic project properties:



482580363

The first line contains the name of the project. Give your project a unique name that you will recognize again in the future.

The second line specifies the directory in which the project is to be saved. Choose the directory using the [Browse] button. The directory must already exist.

If a subfolder with the name of the project is to be created in the specified path, you must mark the "Create project subfolder" box. The project file is then stored in the subfolder.

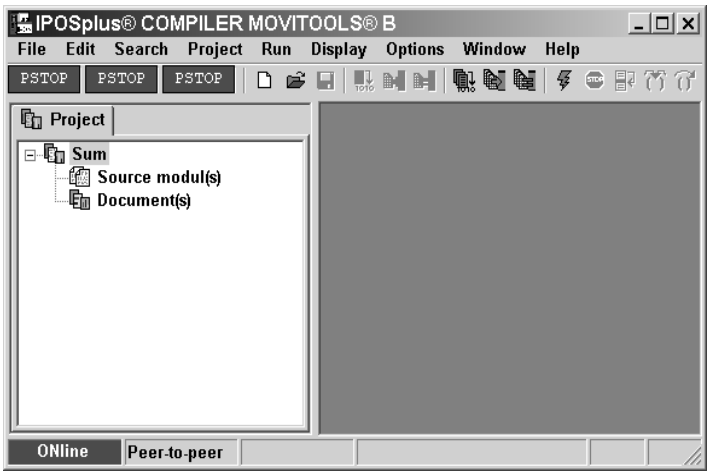
The fourth line specifies the directory in which the Compiler is to search for the files. These files are added to the source text files using an #include statement. The directory created during the installation is entered here as a default, for example: c:\programme\sew\movitools\projects\include.

Lines 5 and 6 specify the directories in which the MDX file (file with the IPOS$^{plus®}$ program) and the list file (file with additional program information) are to be created. These files are only created if you have checked the appropriate boxes under [Extras]/[Settings]/[Compiler].

Once you have confirmed your entries by clicking [OK], the Compiler performs the following steps:

- It creates the folder Total in the specified directory (only if you selected the option "Create project subfolder").
- It creates a project file with the name Total.icp in the Total folder.
- It closes the dialog box.

The project now appears as a hierarchical tree in the project window of the program window:



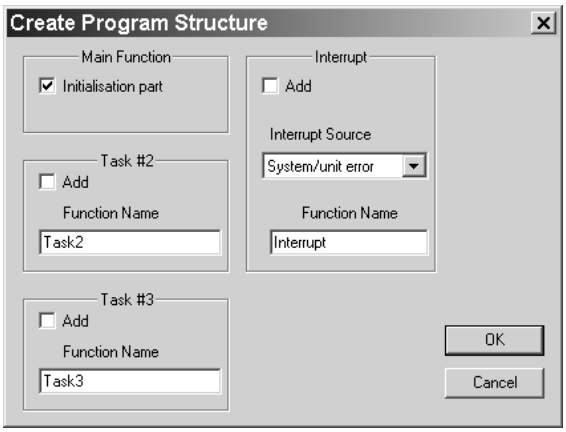
482803339

The next step is to create a new source text file and add it to the project. To do so, choose [File]/[New]/[Source file...].

Confirm this dialog box with [Yes]. A new source file is added to the project. You are now asked to enter a name for the new source file. Enter the name `summe.ipc`.

When you click [Save] another window appears. You create the program structure here.

Defining the program structure



482809355

In the "main function" group, mark the "Initialization part" check box. Once you have left the dialog box by confirming your entry with [OK], the "Main" function is automatically generated with the initialization part. The source file now has the following content:

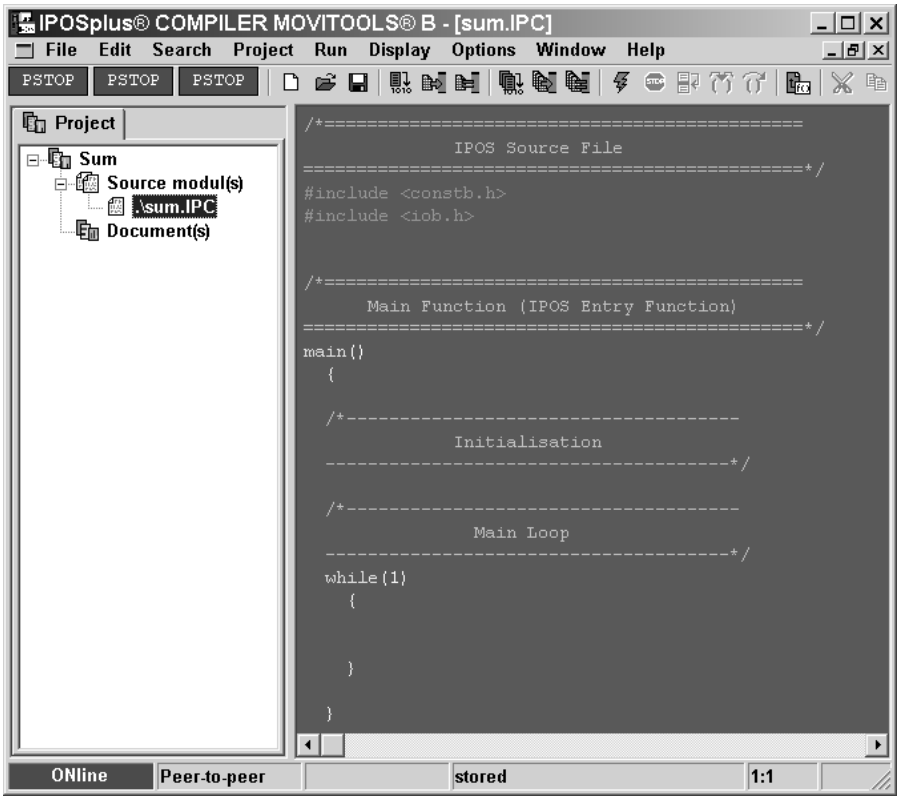
```
/*============================================
IPOS source file
============================================*/
#include <constb.h>
#include <iob.h>

/*============================================
Main function (IPOS initial function)
============================================*/
main()
{

 /*-----------------------------------
 Initialization
 -----------------------------------*/

 /*-----------------------------------
 Main program loop
 -----------------------------------*/
 while(1)
 {

 }

}
```

The `#include <constb.h>` command for MOVIDRIVE® B inserts the header file, which defines the arguments for all the system functions.

The `#include <iob.h>` command for MOVIDRIVE® B inserts a file containing the definitions of the digital inputs and outputs. These constants and definitions can be accessed directly during programming.

The "Main" function contains an initialization part and the main program loop. This is a correct program that could be run, but it does not, however, contain any functions.

The program window now looks as follows:



482850699

If you make changes to the source text, save the project using [File]/[Save All]. Close the program by choosing [File]/[Exit].

13.2.3 Step 3: The first IPOS$^{plus®}$ program

This section is to assist you in creating your first IPOS$^{plus®}$ program.

Editing the IPOS$^{plus®}$ program

Start the Compiler again. This time, the project and the `summe.ipc` file are loaded automatically as they were open when you exited the program.

To get to know all further functions of the IPOS$^{plus®}$ Compiler, you will now write a program that adds together all the numbers from 1 to 100.

Rather than using the formula (n+1)×(n/2) for this, you should program a loop that adds up the total by iteration.

The program should, therefore, have the following structure:

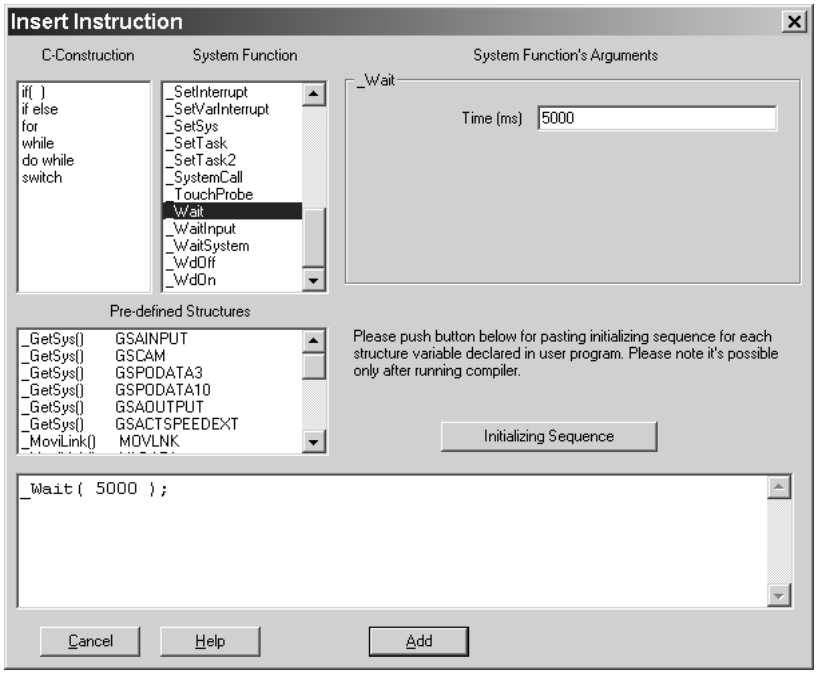
483418763

"Changed" is displayed in the status bar. This means the program has been changed compared with its status when last saved. Save the program. "Saved" is now displayed in the status bar.

Syntax highlighting is used so that words with different meanings are shown in different colors to give you a better overview. For example, all names that the Compiler recognizes (key words) are shown in yellow. The system functions provided by the unit are highlighted in blue.

You can use the insert tool while you are editing the program. Click the right mouse button to open the context menu containing the [Insert Instruction...] menu item. This menu item allows you to call up the insert tool.

Calls insert tool



483423627

You can use the insert tool to select various C-constructions, system functions and predefined structures. When you select a system function, you have to enter the arguments of this function in the group box to the right of the window. Use [Add] to insert the relevant command to the position where you have placed the cursor in the source text.

To insert the _Wait function, you must first select the _Wait function in the list of system functions. The right-hand side of the window displays the arguments relating to the corresponding function. For our example, enter the value 5000 (stands for 5000 ms).

If you require additional information on a C construction or a system function, simply select the term in question in one of the two lists and press the <F1 key> or the [Help] button.

You can activate the help function from the source text by placing the cursor on the key word _Wait and pressing the <F1> key.

	INFORMATION The Compiler is case sensitive, which means that there could be 2 different variables for MYVAR and myvar.

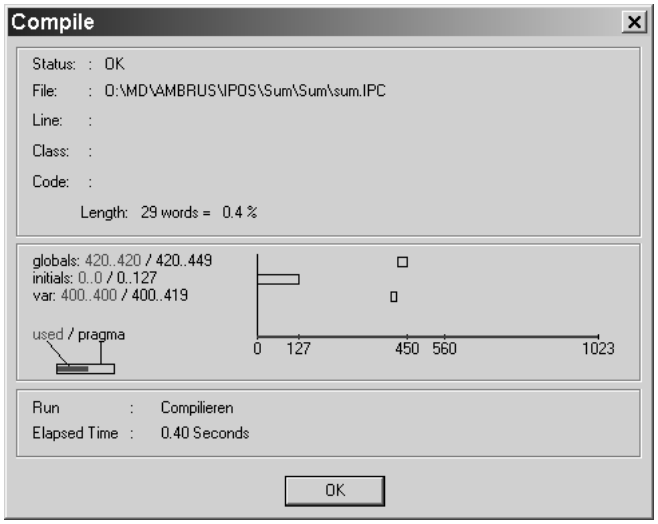
13.2.4 Step 4: Compiling and starting the IPOS$^{plus®}$ program

In this chapter, you will compile the program you created in step 3, load it into IPOS$^{plus®}$ and run the program.

Compiling the program

To generate a program in a form that the inverter can understand, the project must be compiled. To do so, press the icon or choose [Project]/[Compile].

Message window displayed after compilation



483686539

The message window displayed above appears after the project has been compiled. If the program does not contain any errors, it is assigned the status OK. The size of the program is also important. It is specified as the length of the code words used in Assembler code. This absolute number is also converted to a percentage that specifies how much memory space is used in IPOS$^{plus®}$.

The compilation process was successful for our program. The program is 29 IPOS words in size; that is, it takes up 0.4 percent of the entire IPOS$^{plus®}$ memory capacity.

Close the window by choosing [OK].

Error messages during compilation

As syntax errors can occur during programming, an error reporting system has been integrated in the IPOS$^{plus®}$ Compiler. If the program detects an error, it displays the line in which the error occurs and generates a corresponding error message classifying the error.

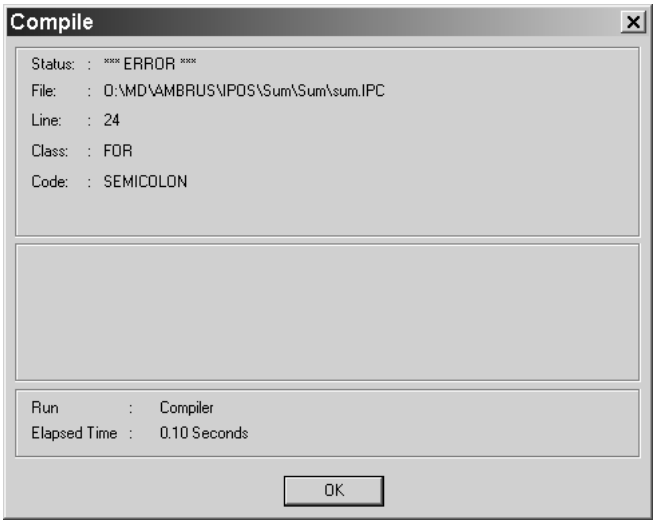
Observe the following example..

Change the FOR loop as follows:

```
while(1)
{
   for (H1 = 0; H1 <= 100)
 {
  °°// Calculate sum
    H2 = H2 + H1;
    // Wait 5 s
   _Wait( 5000 );
 }
}
```

In this example, the third argument of the FOR loop is missing. When you compile the system using the icon, the following message appears:

Error message during compilation



483692427

The status ERROR is output as an error has occurred. The line, error classification and the error code are also displayed. Furthermore, the program line in the source file containing the error is highlighted with a red bar.

Click the [OK] button and then rectify the error. The compilation process must be repeated again once you have rectified the error.

Rectify the error by correcting the FOR loop as follows:

```
while(1)
{
   for (H1 = 0; H1 <= 100;H1++)
 {
  °°// Calculate sum
    H2 = H2 + H1;
    // Wait 5 s
   _Wait( 5000 );
 }
}
```

Loading the program into the unit

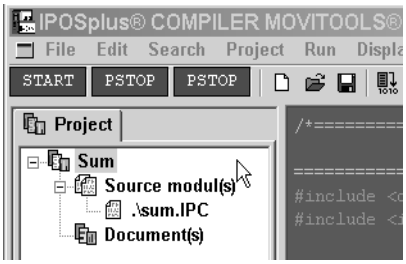
As the next step, the program must be loaded into the inverter. To do so, press the icon or choose [Project]/[Compile and download]. The program is compiled again and loaded into the inverter once it has been compiled successfully.

The first program line in the "Main" function is marked with a light blue bar once the program has been downloaded successfully. You can now start the program.

Starting and stopping the program

You can start the program by clicking the icon. The program now runs in MOVIDRIVE® and the START status is displayed in the toolbar.

Status START



483713291

At the same time, the light blue bar in the program is deleted.

You can see that the program is being processed. In this small test program, the variable H2 is incremented in steps of 5 s.

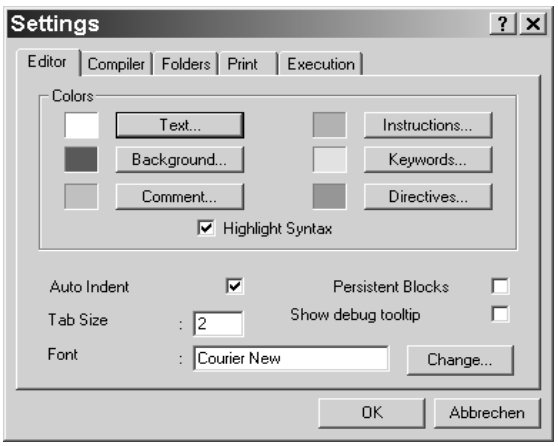
To see this, open the variable window by choosing [Display]/[All Variables]. You can now observe the variable H2.

Now we want to stop the program. This is done by pressing the icon . After this, the first program line in the "Main" function is marked with a light blue bar.

13.3 Settings for the IPOSplus® Compiler

You can make a number of settings for the entire Compiler. To do so, choose [Options]/ [Settings]. The following dialog box appears:

Editor settings



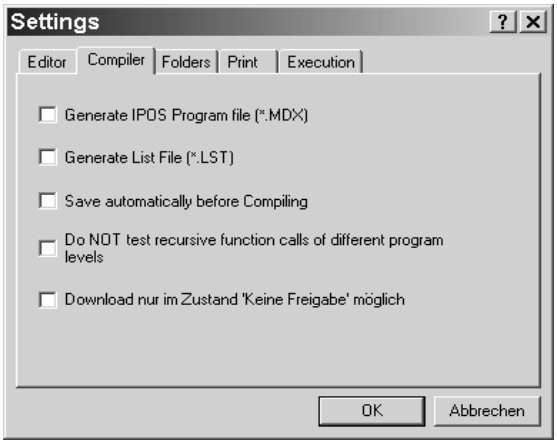
483719691

In the Editor settings, you can select the colors for the background and the text. In the same way, settings can be made for the syntax highlighting colors, for displaying the syntax of instructions and keywords in color.

In addition, the following settings can be made:

- Color syntax display: Activate and deactivate the syntax highlighting for instructions and key words.
- Automatic indent: The cursor is indented automatically in line with the first character of the previous line when you change to a new line by pressing the Enter key.
- Persistent blocks: Selected blocks remain marked until a new selection is made. If this option is deactivated, the text block selection mark disappears when the cursor is moved. Pressing a key causes the selected block to be replaced.
- Tab size: Number of characters by which the cursor is indented when the Tab key is pressed.
- Font : Select the font by clicking the [Change...] button.
- Show debug tooltip: If the [Show debug tooltip] option is activated, the content of variables is displayed directly in the Editor window when the cursor is placed on the required variable.

Compiler settings



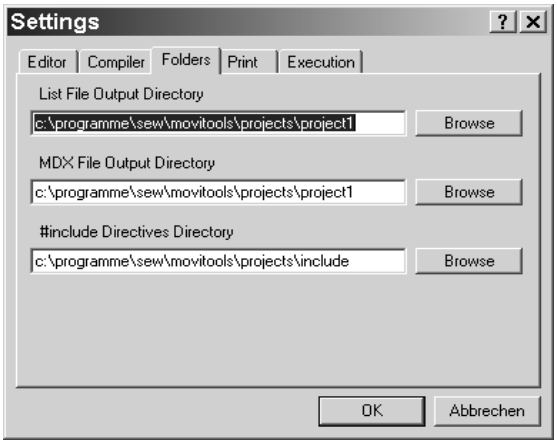
483721227

You can make settings for the Compiler process on the Compiler tab page.

- Generate IPOS program file (*.MDX): An *.MDX file is generated during compilation. The MDX file contains the Assembler code of the program in text form and can be loaded into the inverter via SHELL (Copy unit data) or opened in the Assembler.
- Generate List File (*.LST): A list file is generated and saved during the compiling process. It contains information on resource utilization and the program sequence.
- Save automatically before compiling: If this checkbox is selected, the source code is saved automatically before the start of each compiling process.
- Do not test recursive function calls: If this checkbox is not selected, the Compiler reports an error when it detects a recursive function call. If you want to permit recursive function calls, you can deselect this checkbox. The Compiler only issues a warning message.
- Download only possible in the status "No enable": If this checkbox is selected, an IPOS$^{plus®}$ program can only be downloaded to the inverter when it has the status "No enable".

	INFORMATION Uploaded programs created by the Compiler can be opened but not processed with the Assembler.

Directory settings:



483837963

In the IPOS$^{plus®}$ Compiler, a program can either be created as a project or as an individual source file.

If the program is created as an individual source file, you must make the following settings as shown in the window above:

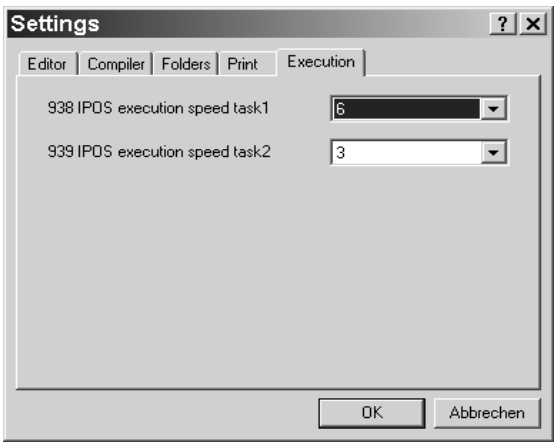
In the [List File Output Directory] field, specify the folder in which the list file should be saved if this function has been activated in the Compiler settings. You can search for and select this directory by clicking the [Browse] button.

In the [MDX File Output Directory] field, specify the folder in which the MDX file should be saved if this function has been activated in the Compiler settings. You can search for and select this directory by clicking the [Browse] button.

The [#include Directives Directory] setting is made in the last line on this tab. This field contains the details of the directory in which the header files linked with the #include command are stored.

If an IPOS$^{plus®}$ program is created as a project, the settings in the [Directories] tab page are not relevant.

Settings of the task interpreter steps:



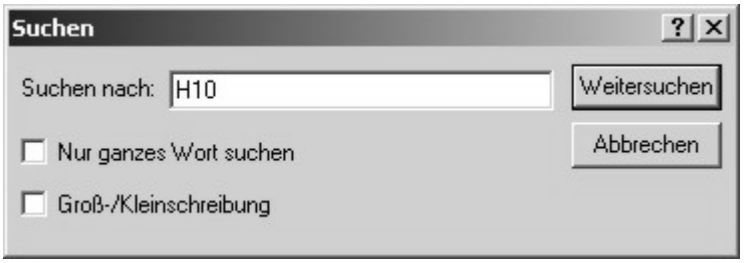
483839499

On the [Run] tab, you can set the speed parameters for task 1 and task 2. These settings are described in detail in section "Task Management and Interrupts / Tasks for MOVIDRIVE® B".

13.4 Search function

Choose [Search]/[Search for...] from the menu bar. If you have marked a section of text, this text will be used as the search string (in the following screen this is "H10"). The following window appears:

[Search] window:

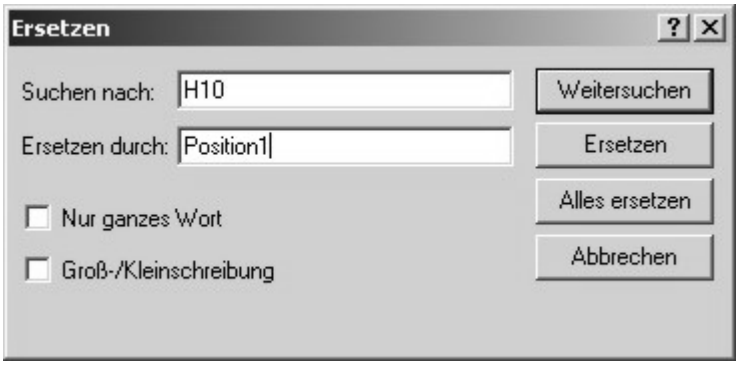


484333835

Click the [Find Next] button to search for the next occurrence of the word in question. Click [Cancel] to close the window again.

The same functionality is also available for the [Replace...] function in the [Search] menu item in the menu bar.

[Replace] window:



484363787

The [Find Next] button can be used to search for the corresponding word, which can then be replaced with another word using the [Replace] function. Click the [Replace All] button to replace all strings matching the search term. Click [Cancel] to close this window.

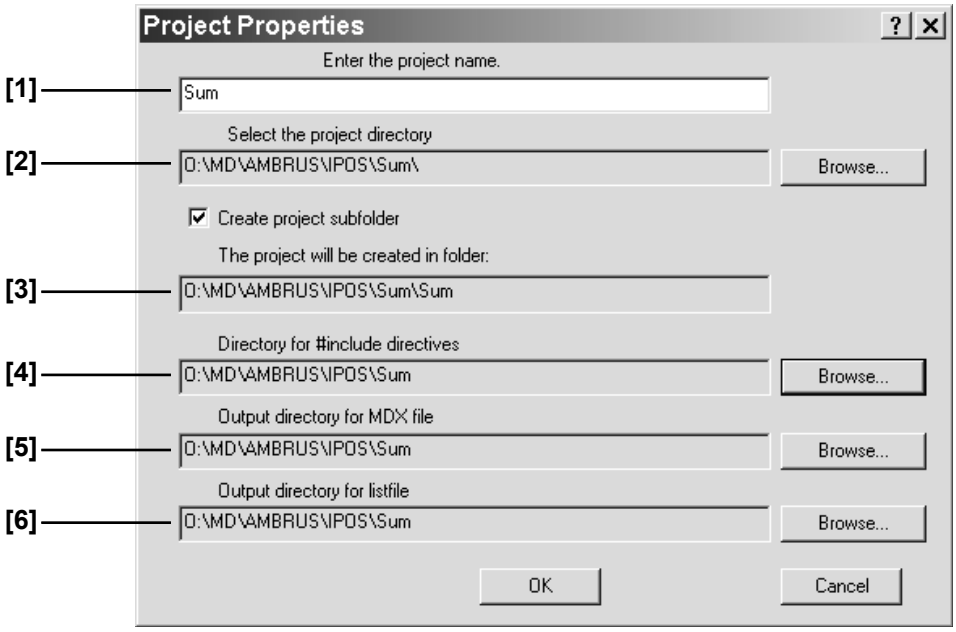
13.5 Creating a new project

An IPOS$^{plus®}$ program consists of one or more source text modules. Each module is stored in a separate file with the extension *.IPC. Information about the project is stored in a project file with the extension *.ICP. This binary file is stored and administered by the Compiler.

13.5.1 Project properties

Select [Project]/[Create new]. A dialog box appears: Enter the general project characteristics here.

Project properties



484369163

[1] Name of the project.
[2] Directory of the project.
[3] Directory in which the project folder is created.
[4] Directory in which the files that are inserted using the #include instruction are stored.
[5] Output directory for MDX file (if activated).
[6] Output directory for list file (if activated).

Once you have confirmed your entries by pressing the [OK] button, the newly-created project appears in the tree structure in the project window.

The root node is the project name. The nodes `Source file(s)` and `Documents` are listed below the root node. The source modules (*.IPC files) are listed below the `source file(s).`

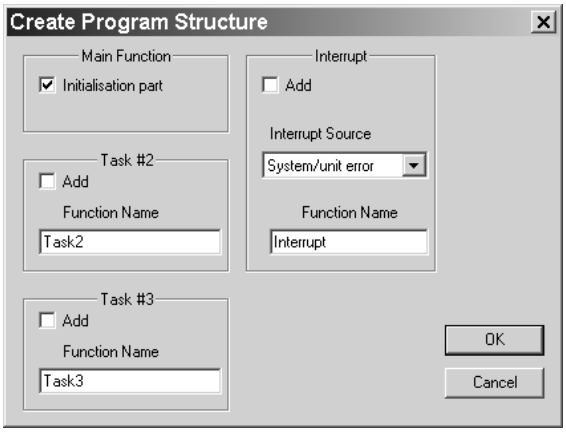
All the source modules contained therein are compiled to form an IPOS$^{plus®}$ program.

Under the `Documents` node, you can attach any files required for documentation (for example, Word documents) (right mouse click: "Add document to the project"). All files in this node are excluded from the compilation process.

In the next dialog box that appears, give the new source file a name. If you exit the box by selecting [Save], another dialog box opens.

This dialog box can be used for defining a basic program structure which is displayed as an empty program template in the Editor window.

Defining the program structure



484387339

13.5.2 Defining the program structure

Select the [Initialization part] check box if the main program is to contain an initialization part in which, for example, variables are initialized.

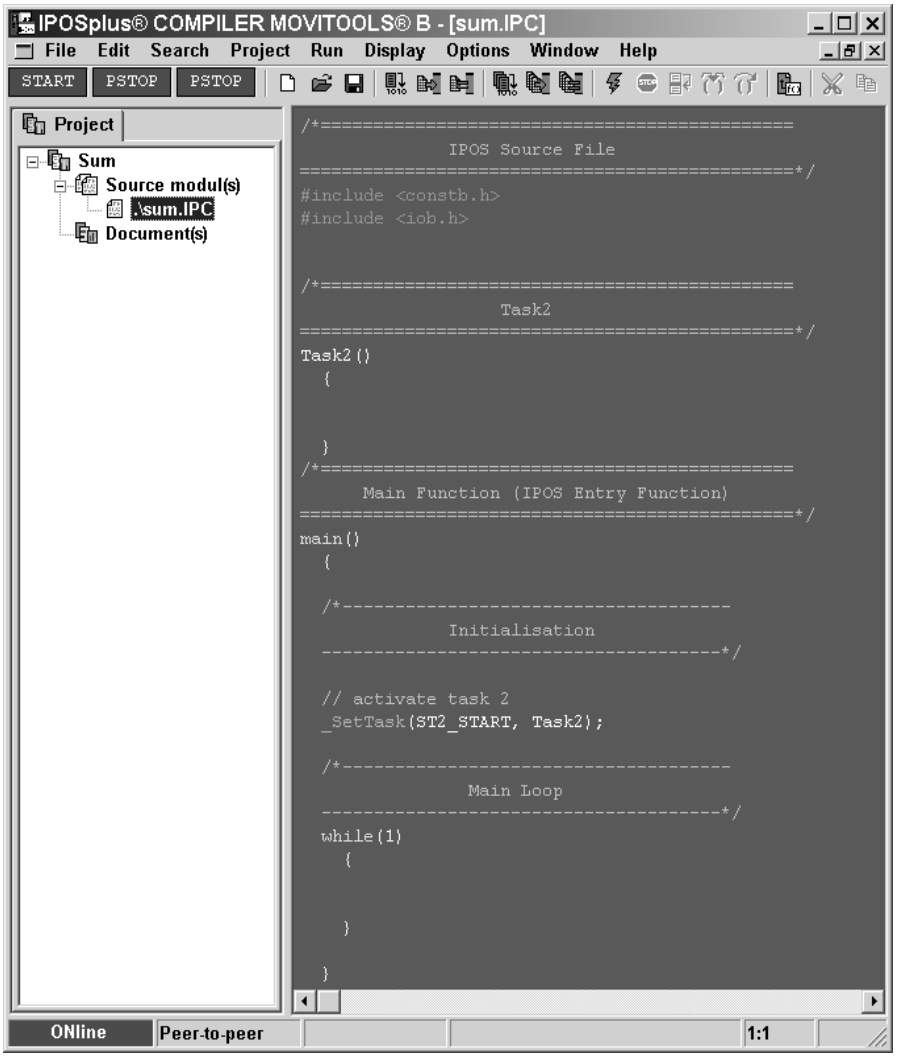
Also, select the [Add] check box for task 2 / task 3 if a basic structure for task 2 / task 3 is to be created. In this case, it is also possible to enter the function name for task 2 / task 3 which is then directly adopted in the basic structure. An initialization part is automatically added to the basic structure if a task 2 / task 3 is added. This part contains the command for starting task 2.

If an interrupt routine is to be programmed, its basic structure can also be created at this stage. This structure is created by selecting the corresponding [Add] check box. Use the [Interrupt Source] selection field to select whether it is to be an interrupt for an error, timer or touch probe. The specified function name is adopted in the basic structure as the name of the interrupt function. A statement line for activating the interrupt routine is inserted in the initialization part.

Click the [OK] button to complete the process of selecting the program structure. If you click the [Cancel] button to complete the selection process, the program displays an empty editor window without a program structure. This is required, for example, for creating your own header file.

For instance, if a structure with an initialization part and a task 2 is selected, in which task 2 is to have the function name ”Monitoring", the resulting Editor window displays the following program structure:

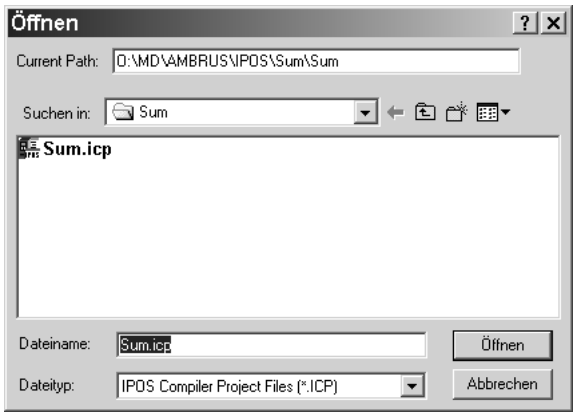
Compiler program:



484392715

	INFORMATION The IPOS$^{plus®}$ Compiler is case sensitive, which means that there could be 2 different variables for MYVAR and myvar. "ß" is not permitted.

You also have the option of adding an existing source file to a project. To do so, click the right mouse button on the `Source file` root node and select [Add source file to project] from the context menu that appears. The following dialog box appears.



484398091

The file type is preset to *.ipc. Files with the ending *.ipc indicate source files. Header files with the ending *.h can also be selected and assigned to the project.

When a file is selected, it appears under the source file(s) root node and is assigned to the project.

13.6 Saving a project

There are several options for saving a project and the corresponding source files.

- The complete project and all the source files in it can be saved by choosing [File]/[Save All].
- If only changes made to the source file currently in process are to be saved, you can do so by choosing [File] [Save] or the icon from the toolbar.
- Choose [File]/[Save As...] to save the source file active in the project window under a different name.

13.7 Setting up a project management structure

A project management structure allows you access to all data relating to a project. For example, the following folder structure gives a clear overview:

- Main project (e.g. machine or customer)
  - Complete documentation (documents for entire project)
  - Project (single inverter)
    - Documentation (documentation for the individual drive if it is not stored in the complete documentation)
    - Source (all *.IPC files, all *.h files, including const.h)
    - Parameters (*.mdx file for unit exchange)
    - Measurements (Scope files)
  - Project (single inverter)
    - Documentation (documentation for the individual drive if it is not stored in the complete documentation)
    - Source (all *.IPC files, all *.h files, including const.h)
    - Parameters (*.mdx file for unit exchange)
    - Measurements (Scope files)

Example:

- Customer: Müller
  Machine: Hoist station
  MOVIDRIVE®: hoist axis, fork drive
  - Complete documentation
  - Hoist axis
    - Documentation
    - Source
    - Parameters
    - Measurements
  - Fork drive
    - Documentation
    - Source
    - Parameters
    - Measurements

A project management structure such as this permits anyone who has to familiarize themselves with the machine or the program to obtain a rapid overview. Documentation and source texts can be located quickly, making it easy to keep an overview. This facilitates easy maintenance of the software and the overall system.

The folders and subfolders can be created in the project management.

13.8 Opening a project

If the Compiler is opened, the Editor is opened with the last source text to be processed in the last project that was opened, as long as the IPOS$^{plus®}$ Compiler was exited when the Editor window was open.

An existing project can also be opened by choosing [Project]/[Open].

You can search for the project file in the dialog box and open it using the [Open] button.

13.9 Handling projects with MOVIDRIVE® B

	INFORMATION MOVIDRIVE® B allows you to store an error-free, compliable project with all the accompanying files in MOVIDRIVE®. The complete source code can be stored in MOVIDRIVE® and called up at any time.

13.9.1 Saving a project in the inverter

Choose [Project]/[Download] to save the current project and all the accompanying data, including the project file itself, in the MOVIDRIVE® unit.

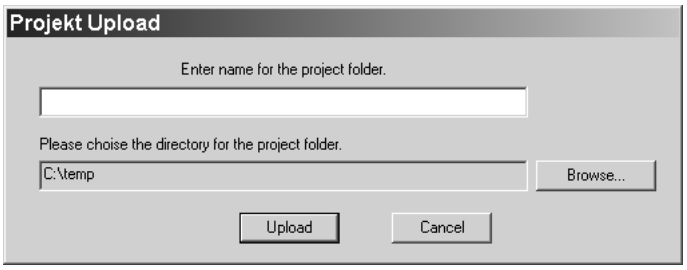
The project is compiled before it is downloaded. If the compilation process fails, the data is not downloaded.

If the available memory space in the inverter is too small, an error message is generated and the process is canceled.

	INFORMATION Downloading the project data does not automatically download the compiled IPOS$^{plus®}$ program.

13.9.2 Loading a project from the inverter

Choose [Project]/[Upload...] to load a project stored in the inverter to the PC/laptop.



484532491

You can enter the name of the project folder in a dialog box. Select a target directory via the [Browse] button.

If a project file with the same name already exists in the directory, the system asks whether it should overwrite this file.

If there is no project data in the inverter, the process is canceled.

13.9.3 Calling up a project from the inverter

This function is used to update the project on the PC/laptop with the files from the inverter.

As opposed to [Project]/[Upload], this menu item loads the files stored in the inverter memory and copies them to their original directories.

If a file with the same name already exists in the directory, the system asks whether it should overwrite this file. The creation date is entered for both files to help identify them.

If there is no project data available, the process is canceled.

13.10 Compiling a project

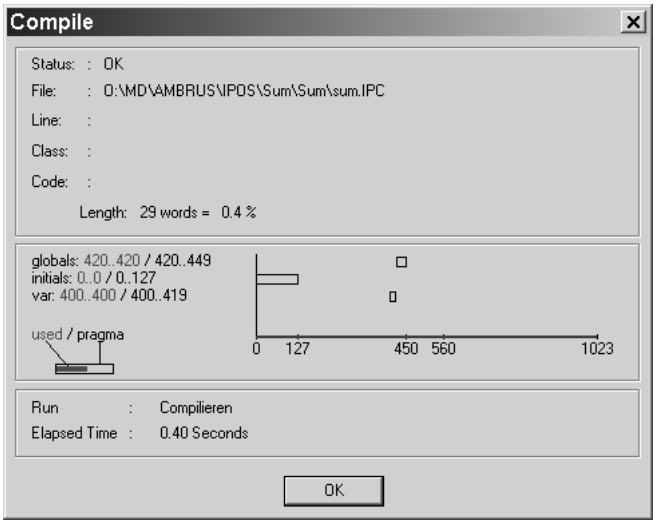
To generate a program in a form that the inverter can understand, the project must be compiled. If a project consists of several source files, all source files are compiled to an IPOS$^{plus®}$ program during the compilation process.

Project compilation can be started by choosing [Project]/[Compile] or by clicking .

The file is also saved if the [Save automatically before Compiling] function has been activated in the Compiler settings. In the same way, an IPOS$^{plus®}$ program file and listing file is generated when these settings are activated for the Compiler.

Once the compiling process is complete, the following window appears:

Status window for compilation



484538891

- Status: Result of the compiling process: OK or ***ERROR***.
- File: Source file of the project in which the error was detected.
- Line: Program lines in which the error was detected.
- Class: Error class of the error.
- Code: Error code of the error.

The status window also contains information about the length of the generated program code and the memory utilization in the inverter. The length of the program code is entered as the number of the code words used in the Assembler code. This value is used to calculate and display the memory utilization in percent.

Press the [OK] button to leave the status window. In case of an error, a red bar highlights those lines in which the error occurs.

If several errors occur in one program only the first error is displayed in the status window. Once this error has been rectified, compile the project again and the next error will be displayed in the status window.

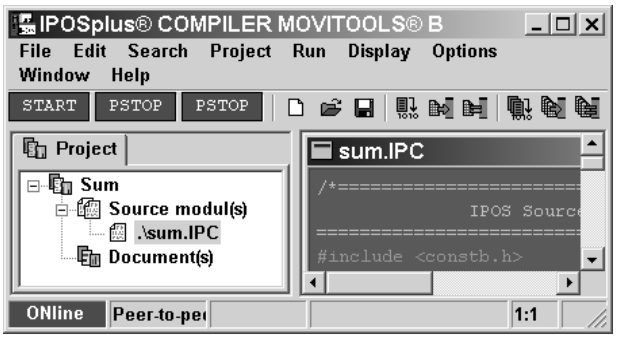
13.11 Compiling and downloading

Two basic steps are required to transfer the program to the inverter. First, the source text must be compiled. Second, the program must be transferred to the inverter. Trigger these two steps by choosing [Project]/[Compile + download]. The basic conditions for compiling are the same in principle as those described in the previous section. However, an explicit message only appears if an error occurs. You can tell when the Compile + Download function has been successful because the first program line of the MAIN function is marked with a light blue bar at the end of the process.

13.12 Starting a program

A program can be started once it has been downloaded to the inverter. To do this, select the [Start] menu command from the [Run] menu in the menu bar. Alternatively, you can also press the icon in the toolbar. The light blue bar in the editor is deleted once the program has been started. The display for the task status changes from PSTOP to START.

Status displays for task 1 and task 2:



484635147

13.13 Stopping a program

Select the [Stop] menu command from the [Run] menu in the menu bar to stop the programs in task 1, task 2 and task 3. Alternatively, you can also press the icon in the toolbar. The display for the task status in the tool bar changes from START to PSTOP.

13.14 Comparison with unit

There is a comparison function for comparing the content of the Editor window with the program in the inverter. This function can be called up by selecting the [Compare with inverter] menu item from the [Project] menu in the menu bar. You can also call the function by pressing the icon in the toolbar.

13.15 Debugger

The integrated debugger is a useful tool for working through a program for test purposes or for troubleshooting in individual steps. To use the debugger, the program must be transferred to the inverter. Three different functions are available for debugging.

Function	Symbol	Key	Description
Execute to cursor		<F4>	Program is only processed up to the current cursor position.
Single step		<F7>	The program line highlighted by the cursor is processed. If a function is called, the program branches into this function.
Skip		<F8>	If the program lines highlighted by the cursor contain a function call, the system does not branch to the function and the program line is skipped.

Click the icon in the tool bar, function key F5 or the [Stop] menu command from the [Run] menu in the menu bar can be used to stop and reset the program at any time during debugging.

Click the icon in the tool bar, function key F9 or the [Start] menu command from the [Run] menu in the menu bar can be used to start the program from the current cursor position at any time during debugging.

While the program is running, you can interrupt it by pressing the Alt+F5 key combination or choosing [Run]/[Break]. The execution bar is now positioned at the command that is to be executed next.

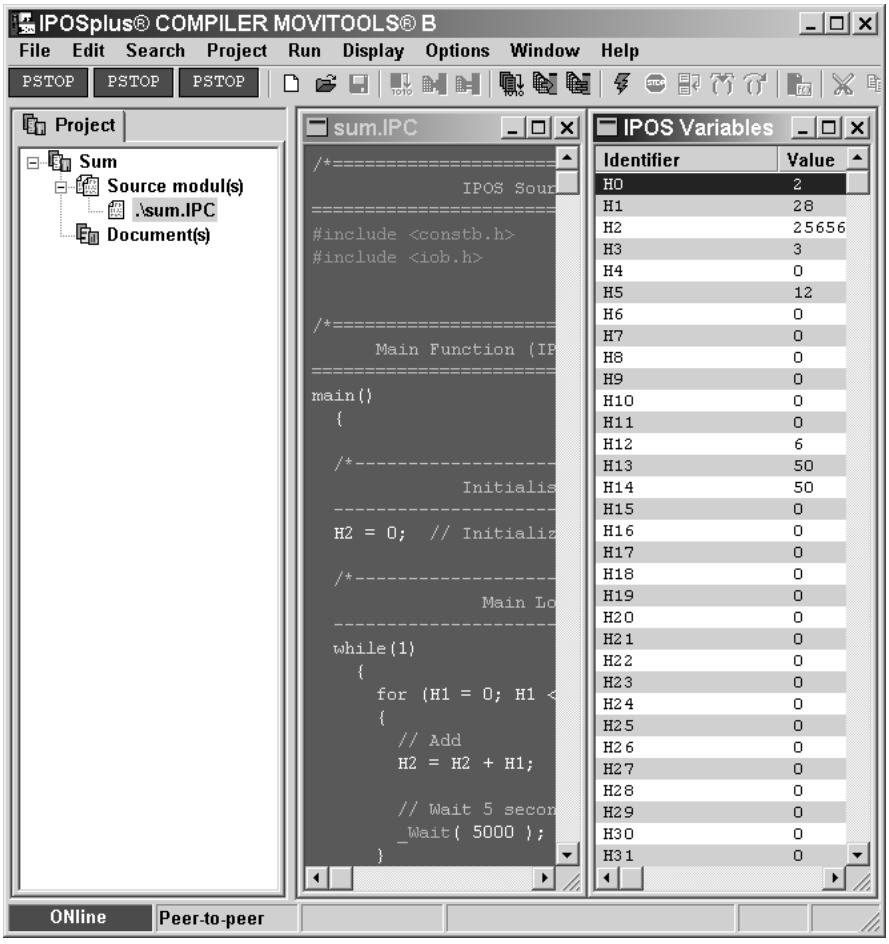
The program can also be interrupted by pressing the F4 key or choosing [Goto Cursor]. The program is stopped in the command line in which the cursor is positioned.

13.16 Variable window

It is useful to open a Variable window so you can observe the contents of the variables during debugging or normal running of the program.

The Variable window is called up by selecting [All Variables] from the [Display] menu in the menu bar.

Displaying variables



485381387

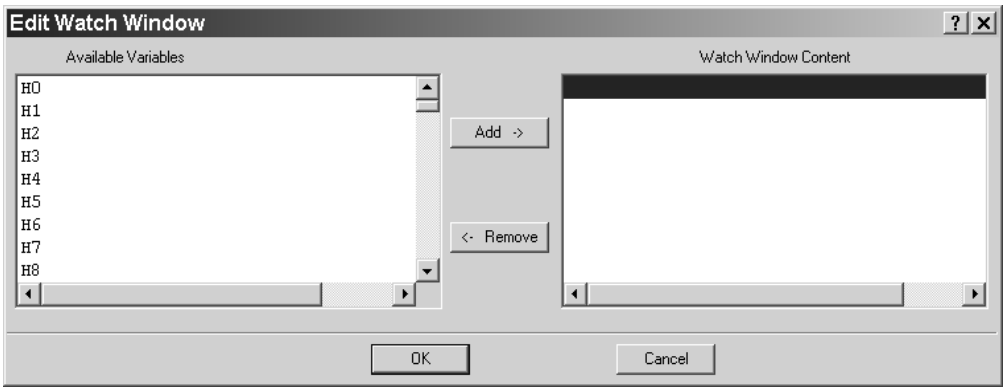
All variables can be observed in the variable window using the scroll bar.

Another way to observe variables is to set up a watch window. Only selected variables are displayed in the watch window. The fewer variables displayed at the same time, the faster an individual value can be updated.

	INFORMATION The IPOS variables contained in the data backup of the device can also be displayed in offline mode. The non-volatile variables are displayed with their permanently stored value. The volatile changes by the program code are **not** stored in the backup.

To set up a watch window choose [Display]/[Variable Watch]/[Edit Window...] from the menu bar. The following window is displayed:

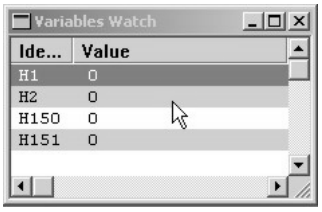
Selecting variables



485591563

Double click on the variable you want to display, or select a number of variables and press [Add] to assign the required variables to the watch window. The selected variables are displayed in a list to the right of the window. To remove a variable from the watch window, you must highlight it in the list and press [Remove].

Displaying the selected variable:



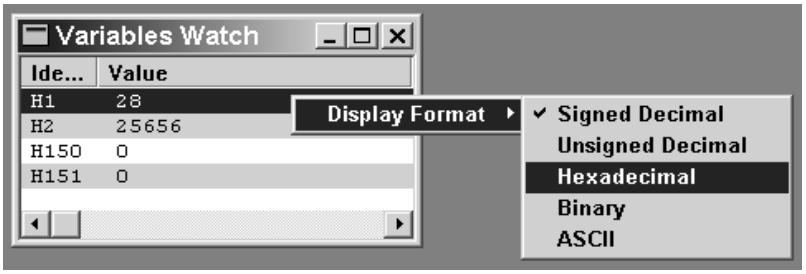
485597579

The window looks the same as the complete variable window, but it only contains the selected variables.

Variables can have symbolic identifiers assigned to them because standard variable names (e.g. H1, H2, etc.) are hard to follow in big programs. These identifiers are also displayed at this point.

The values of the variables can be displayed in different formats. You can select from the following formats: signed decimal, hexadecimal, binary or ASCII. To change from one format to another, first select the required variable by clicking it. Then call up a context menu by pressing the right mouse button, and select the required format from there.

Changing the variable format:



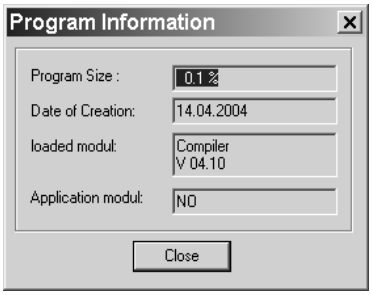
485601931

Individual variables can also occur several times in the watch window. In this way, a variable can be displayed in various formats at the same time.

13.17 Program information

The [Program Information] menu command is available in the [Display] menu in the menu bar. If you select this menu item, the following window appears:

Program information



485608587

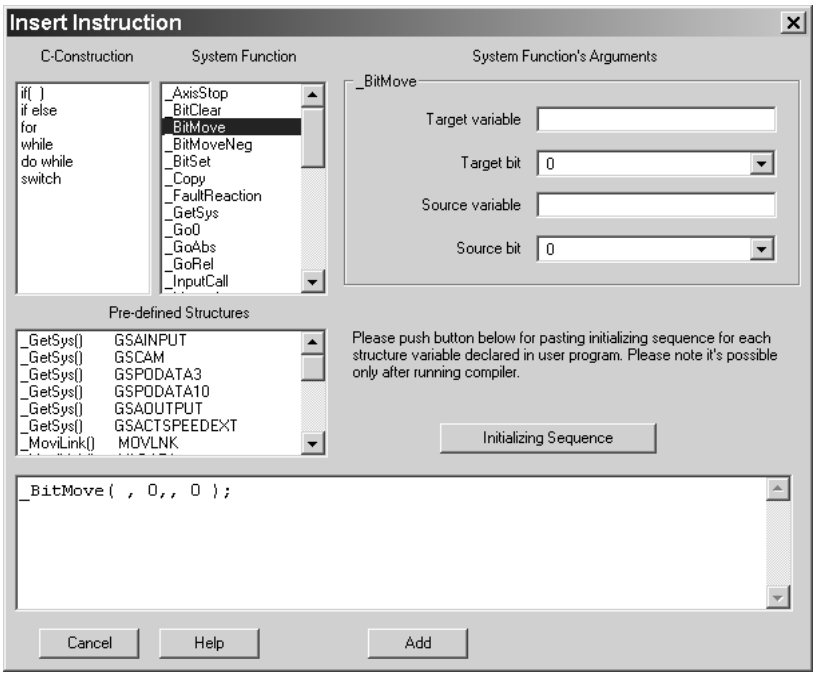
This program information refers to the program stored in the inverter. The size of the program, creation date and name of the source file are displayed in this window. Click the [Open File] button to display the source code for the program in the inverter in an Editor window. This assumes that the name of the source file has not been changed and can be located in the path that was used to transfer the program to the inverter.

13.18 Entering instructions

In principle it is possible to enter the entire source text of an IPOS$^{plus®}$ program by typing it in using the keyboard. In this case, use the syntax based on the programming language C. You can undo the last five entries by using the key combination [Ctrl + Z].

You can use the insert tool while you are editing the program. This can be called up by pressing the right mouse button to open a context menu and then selecting [Insert Instruction]. You can also call up the insert tool by pressing the icon in the toolbar.

Inserting an instruction:



485614475

You can use the insert tool to add C-constructions, system functions or predefined structures to the source text.

If you mark a C-construction or a standard structure, the text that will be inserted in the source text appears in the lower section of the window. If you want to insert a system function, you must also enter arguments of the function in the right-hand side of the window. Click the [Add] button to insert the selected function in the text where the cursor was positioned when you called the insert tool.

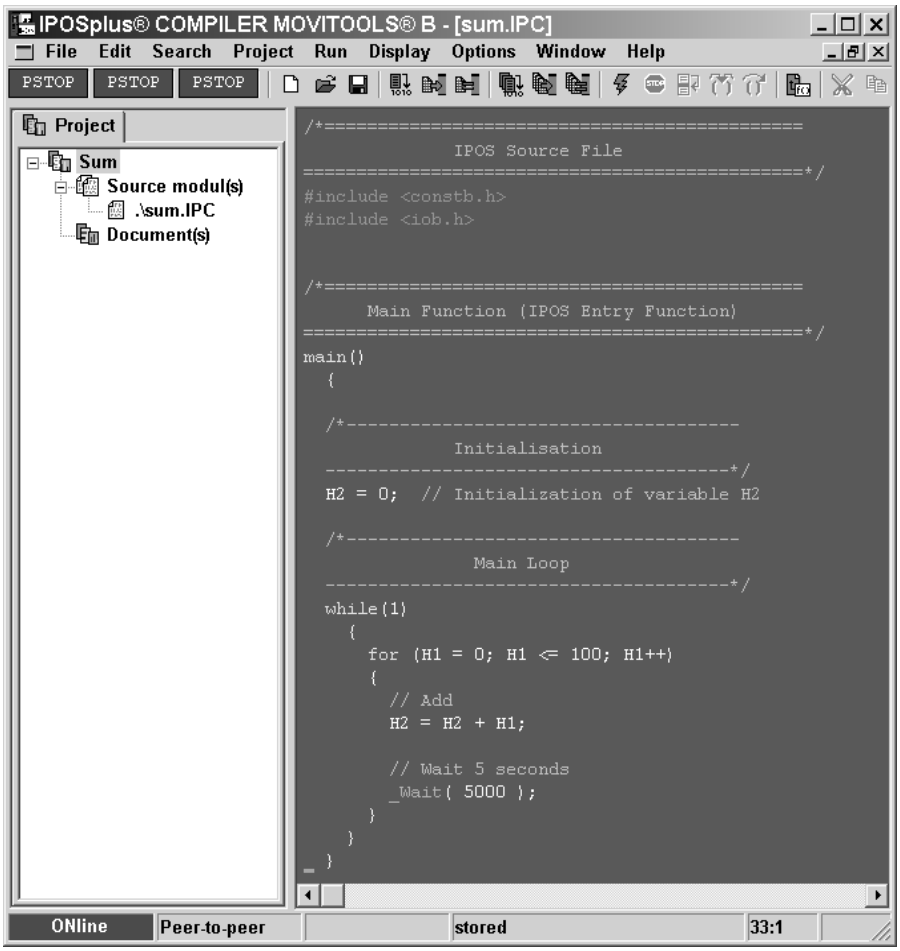
An initialization section is added to the defined structure variable if you click [Initializing Sequence]. To do so, the program must have been compiled at least once.

13.19 Comments

Good use of comments makes it easier to read a program and also makes it possible for someone who does not know the program to become familiar with it quickly.

A long comment, which may span several lines, for example, starts with '/*' and ends with '*/'. A one line comment starts with '//' and does not need an end mark. A single line comment can also be entered directly after a command line in the source text.

Comments



486824075

13.20 Overview of the icons

Symbol	Menu item	Description
	File → new	Creates new source file
	File → open	Opens source file
	File → save	Saves source file
	File → compile	Compiles source file
	File → compile + download	Compiles source file and downloads it to inverter
	File → compare with inverter	Compares source file with the program in the inverter
	Project → compile	Compiles project
	Project → compile + download	Compiles project and downloads it to inverter
	Program → compare with inverter	Compares project with the program in the inverter
	Run → start	Starts the IPOS$^{plus®}$ program
	Run → stop	Stops the IPOS$^{plus®}$ program
	Run → run to cursor	Runs program to where the cursor is positioned
	Run → single step	Runs single step
	Run → skip	Skips an instruction (statement)
	Edit → insert instruction	Calls insert tool
	File → print	Prints source file
	Help → user manual	Open online help

14 Compiler – Programming

The source text of a program written with the IPOS$^{plus®}$ Compiler is made up of various parts. These must first be considered individually

```
/*****************************************
File name:          Program_structure.IPC
Date:               04.02.2002
Author:             Thomas Ambrus
SEW-EURODRIVE Bruchsal
Technical Documentation
Brief description:  Source code program struc-
ture
*****************************************/
*/=========================================
IPOS Source File
=========================================*/
#include <const.h>
#include <io.h>
/*=========================================
Main Function (IPOS Entry Function)
=========================================*/
main()
{
 /*-----------------------------------
 Initialization
 -----------------------------------*/
 // activate task 2
 _SetTask2(T2_START, Monitor); // testing

 /*-----------------------------------
 Main Loop
 -----------------------------------*/
 while(1)
 {
 }
}
/*=========================================
Task2
=========================================*/
Monitor()
{
}
/*=========================================
User function
=========================================*/
Reference_travel()
{
}
Automatic_mode()
{
}
Manual_mode()
{
}
```

Comment with notes on the program

Program header with pre-processor statements and, if necessary, definition of the variable

The main function contains the initialization part and the endless loop for task 1

Initialization part

Endless loop for task 1

Task 2, endless loop is not required

Functions (subprograms) created by the user, called up from task 1 and task2

14.1 Preprocessor

The IPOS$^{plus®}$ Compiler is a multi-pass Compiler that processes the source text in several run-throughs. During the first run-through, the preprocessor processes the statements – referred to below as directives – which are intended for it, tests the statements for conditional compiling, deletes comments and finally creates a temporary file for the Compiler. The preprocessor increases flexibility and productivity during programming in the following areas:

- Integration of text from other files (header files) which contain prepared and/or user-defined constants or source text functions.
- Definition of symbolic identifiers to improve the legibility of the source text.
- Definition of directives for conditional compiling to improve portability and simplify test phases.

Each line starting with a # is treated as a preprocessor directive, unless the # is part of a comment. Any blanks before or after the # character are ignored.

Preprocessor directives are generally written at the start of the source text. They can, however, be located anywhere in the program. Depending on the function of the directives, they either apply as of the source text line in which they are located or for the entire program regardless of their location.

14.2 Preprocessor statements

The comment lines in the program header are followed by the preprocessor statements. A statement of this type is inserted as standard when you open a new Editor window.

The '#include <const.h>' statement integrates a header file called const.h when the source text is compiled. This file has a fixed format and must not be modified. Nevertheless, we shall explain the function of a header file with reference to this file. An abbreviated form of the file is printed below as this is sufficient to demonstrate the main aspects.

```
/*============================================
File name: Const.h
File version: 2.20

SEW Include-File for IPOSplus Compiler

Please do not modify this file!

(C) 1999 SEW-EURODRIVE
============================================*/

#ifndef _CONST_H
#define _CONST_H
.
.
.
#define Scope474    H474
#define Scope475 H475
#define DRS_Ctrl H476
#define DRS_Status H477
#define AnaOutIPOS2 H478
#define AnaOutpIPOS H479
#define OptOutpIPOS H480
#define StdOutpIPOS H481
#define OutputLevel H482
#define InputLevel H483
#define ControlWord H484
```

```
#define T0_Reload   H485
#define Reserve4    H486
#define Timer_2 H487
#define Timer_1 H488
#define Timer_0 H489
#define WdogTimer   H490
#define SetpointPos H491
#define TargetPos H492
#define PosWindow   H493
#define LagWindow   H494
#define LagDistance H495
#define SLS_right H496
#define SLS_left H497
#define RefOffset   H498
#define SetpPosBus  H499
#define Reserve6 H500
#define Reserve7    H501
#define TpPos2_Abs  H502
#define TpPos1_Abs  H503
#define TpPos2_Ext  H504
#define TpPos2_Mot  H505
#define TpPos1_Ext  H506
#define TpPos1_Mot  H507
#define Reserve8    H508
#define ActPos_Abs H509
#define ActPos_Ext H510
#define ActPos_Mot H511

#endif
```

The actual structure of the header file starts with '#ifndef _CONST_H' after a general remark section. This "#ifndef" instruction is at least always accompanied by an '#endif'. You can find this '#endif' instruction in the last program line of the header file. The task of this '#ifndef' and '#endif' construction is to prevent the file being linked more than once.

The statements within this construction are only performed if a macro identifier, here '_CONST_H', has not yet been defined (**ifn**ot **def**ined). A '#define _CONST_H' is positioned in the next line of the program to define this macro identifier. Therefore, if the header file is processed during compilation by the '#include <const.h>' command, the '#ifndef _CONST_H' query is initially answered in the affirmative because the "_CONST_H" macro identifier has not yet been encountered. It is then identified immediately with '#define _CONST_H'. Then, if the 'const.h' header file is linked elsewhere in the program, the '_CONST_H' macro identifier has already been identified and the '#ifndef _CONST_H' query is answered in the negative. As a result, processing immediately jumps to the "#endif" statement. This prevents the file from being incorporated unnecessarily more than once, which would lead to an error message.

In addition to the '#ifndef' statement, there is also the '#ifdef' (**ifdef**ined) statement. This statement does not have to be negated. An if-else construction is also possible. In this case, this means that the part of the statement following the "#else" is processed if the "#ifdef" or "#ifndef" query is not fulfilled. This results in the following possibilities:

#ifdef identifier_1 Program text_1 #else Program text_2 #endif	#ifndef identifier_2 Program text_3 #else Program text_4 #endif	#ifdef identifier_3 Program text_5 #endif

Note that these preprocessor statements can also be used to good effect in the main program, not just in header files. As a result, for example, parts of a program can be converted specifically for a machine without having to make major changes to the source text.

14.3 #include

This directive makes it possible to incorporate source texts from other files (header files) into the source text file. Header files are usually used to define constants or macros that are used several times so they are available in different projects. The syntax is:

```
#include <FileName>
```

`FileName` is the complete name of the file that is to be incorporated. It is enclosed by pointed brackets. It is sufficient to state the file name without path information if the file to be incorporated is located in the current folder

The file `BEISPIEL.IPC` contains the main program.

```
#include <CONST.H>
H10 = MAXIMUM_SPEED;
```

The preprocessor replaces the `#include` directive with the content of the `CONST.H` file:

```
#define MAXIMUM_SPEED 3000
H10 = MAXIMUM_SPEED
```

The result after macro expansion is as follows:

```
H10 = 3000;
```

The file `CONST.H` is a header file.

```
#define MAXIMUM_SPEED 3000
```

The #include directives can also be used in nested structures, i.e. an included file can itself contain an #include directive to include another file. Ensure that files do not set up an include loop (they include themselves). This leads to a preprocessor error. We recommend avoiding nesting #include directives to keep the structure clearer.

14.4 Include folders

There are various procedures depending on the folder in which the file to be included is located.

1. If the path of the file to be included is set in the Folders tab in the Compiler settings, then the statement is #include <FileName> where FileName is the name of the header file.
2. If the file to be included is located in the current working folder, then the command is #include 'FileName'. FileName is the name of the file to be incorporated.
3. The folder path must be specified if the file to be incorporated is located in a folder other than those already stated here. For example, the statement for incorporating a file called Test.h located in the root folder would be '#include "c:\Test.h"'.

The best place to put header files you have written yourself is in the current working folder. This allows the program to be written irrespective of the folder path. There is no need to make changes if the program is to be compiled in a different folder and the directory structure of the program is maintained. The program can be compiled immediately.

The setting for the Compiler would have to be changed in the first method, whilst the #include path would have to be edited in the program in the third method before the program could be re-compiled.

INFORMATION

The system searches through the paths in the following sequence if all three methods are mixed:

1. Direct path assignment in the #include statement (method 3)
2. Path assignment relative to the source file (method 2)
3. Path assignment in the #include directive of the settings dialog box.

14.5 #define

The '#define' directive was previously used for identifying a Macro identifier. However, the basic function of the '#define' directive is to define a macro. Macros are used to replace symbols in the source text by strings. This mechanism makes it possible to formulate constants, variables, etc. symbolically. The Compiler only supports macros without parameters. The syntax is:

```
#define MacroIdentifier   <SymbolSequence>
```

Each occurrence of a "MacroIdentifier" in the source text following this directive is replaced by "SymbolSequence" (which may be empty). The MacroIdentifier is defined if the SymbolSequence is empty; it does not have any other function. The symbol sequence must not exceed 75 characters.

In this way, a symbolic notation is assigned to the system variables in the header file. Therefore, for example, variable H474 can be addressed using the symbolic name 'Scope474' or variable H484 using 'ControlWord' once the const.h header file has been incorporated.

Equally, the '#define' directive can be used to assign symbolic names to constant values. As a result, the line '#define MAX_SPEED 1500' makes it possible for "MAX_SPEED" to be written in the source text rather than 1500. This makes it easier to read the source text.

The following example illustrates this point:

```
#define setpoint H123
#define maximum     2000
setpoint = maximum;      // in this line the macro def. "setpoint" and "maximum"
      // are replaced, meaning: H123 = 2000;
```

After each macro expansion, the resulting text is examined again. This makes it possible to use nested macros.

```
#define setpoint H10
#define variable1    setpoint
#define minimum      20+H11
variable1 = minimum;      // in this line the macro definition "variable1" is
      // replaced by "setpoint", then "setpoint" is replaced by
      // "H10", meaning: H10=20+H11;
```

INFORMATION

Ensure that a variable identified with #define has **not** been assigned two system variables by mistake.

INFORMATION

The compilation process cannot detect whether a variable is defined with the same name as a structure. The inverter generates the error 10 IPOS-ILLOP.

Example:

```
#define position H2VARINT position;
```

14.6 #undef

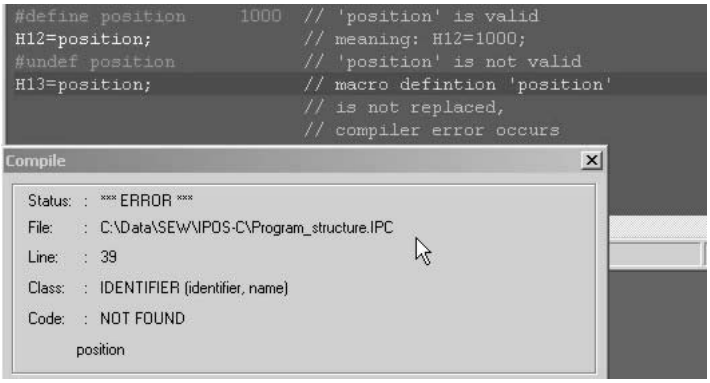
This directive makes it possible to deactivate a macro that was previously created using '#define...':

```
Syntax: #undef MacroIdentifier
```

The following example illustrates this point:

```
#define position 1000  // "position" is valid
H12=position;        // meaning: H12=1000;
#undef position            // "position" is not valid
H13=position;        // macro definition "position" is not replaced,
       // Compiler error occurs
```

Compiler error due to missing definition:


#define position 1000 // 'position' is valid
H12=position; // meaning: H12=1000;
#undef position // 'position' is not valid
H13=position; // macro defintion 'position'
// is not replaced,
// compiler error occurs
Compile
Status : *** ERROR ***
File : C:\Data\SEW\IPOS-C\Program_structure.IPC
Line : 39
Class : IDENTIFIER (identifier, name)
Code : NOT FOUND
position

493925131

14.7 #declare

This directive allows IPOS$^{plus®}$ variables to be declared symbolically and relative to a base variable. This facilitates the portability of source text modules as far as assigning variable numbers is concerned, because the user only has to change the number of the base variable in order to change all the variable numbers used in the source text.

In this way, it is easier to integrate preconfigured modules into your own source text provided that these modules have relative variable numbers.

`Syntax: #declare IdentifierNew  IdentifierOld : Offset`

The following example illustrates this function:

```
#define basevariable H100

#declare setpoint     basevariable:0
#declare actvalue     basevariable:1
#declare i            basevariable:5
```

The following variables are now available as symbolic variables: setpoint, actual value and i. Furthermore, it also specifies that the IPOS$^{plus®}$ variables H100, H101 and H105 are assigned.

	INFORMATION A maximum of 600 #define and #declare directives can be used.

	INFORMATION The task of integrating modules is made easier by forming variable blocks using declare directives. However, this remains quite difficult to handle because the user needs to have an overview of which variables have been occupied and which are still available. As a result, it is a good idea to use structures, SEW standard structures or user-defined structures particularly when a fixed sequence of variables has to be provided (e.g. SETSYS, GETSYS, MOVLNK, and so on). All other variables should be declared with the keywords long or initial long as described below since this leaves the task of assigning variable numbers up to the Compiler.

14.8 SEW standard structures

SEW standard structures provide ready-made structures for commands that are dependent on structures.

The following table shows a list of the standard structures available for each specific statement. For the corresponding elements, refer to the description of the respective command, see section Standard functions (page 208).

Instruction type	Standard structure
_GetSys	GSAINPUT
	GSAOUTPUT
	GSCAM
	GSCAM_EXT
	CAM_EXT_OUT
	GSPODATA3
	GSACTSPEEDEXT
	GSPODATA10
_MovCommDef (only for MQx)	MOVCOM
	MCPDATA
	MCPARDATA
_MoviLink	MOVLNK
	MLDATA
_SBusCommDef	SCREC
	SCTRACYCL
	SCTRCYCL
_SetSys	SSPOSRAMP
	SSPOSSPEED
	SSPIDATA3
	SSPIDATA10

These standard structures are used as follows. First, a variable is declared as the structure variable in the declaration part. Then the elements of the structure are addressed as explained in the following example. The structure is addressed within the command by using the name of the structure variable without additions.

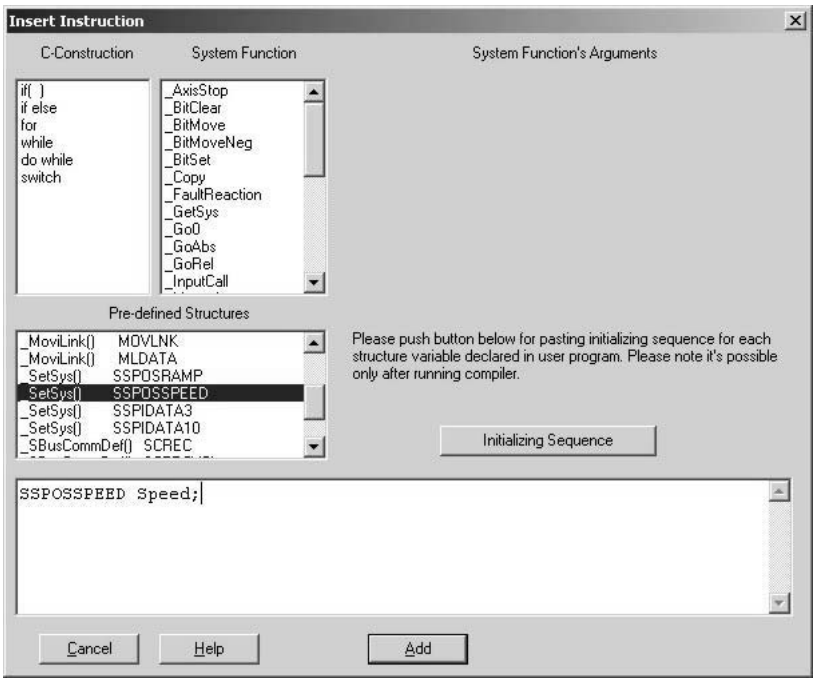
```
// Declare
SSPOSSPEED rapid speed, slow speed;

// Initiate
rapid_speed.cw = 14000;     // rapid speed cw 1400 rpm
rapid_speed.ccw = 12500;    // rapid speed ccw 1250 rpm
slow_speed.cw = 3000;       // slow speed cw 300 rpm
slow_speed.ccw = 4500;      // slow speed ccw 450 rpm

// set rapid speed
_SetSys( SS_POSSPEED,rapid speed );

// set slow speed
_SetSys( SS_POSSPEED,slow speed );
```

The insert tool can be used for support when declaring and initializing standard structures. The cursor must be positioned in the Editor window at the place where the declaration for the structure variables is to be inserted. Call up the insert tool by clicking the right mouse button. A context menu opens: Choose the menu item [Insert Instruction].

You can also call up the insert tool by pressing the icon in the toolbar or by choosing [Edit]/[Insert Instruction] from the menu bar. Select the predefined structure and change the name of the variable in the editing window of the input help. If several structure variables are declared from the same structure type, separate them with a comma.

Once all structure variables have been declared they must be initialized depending on the specific application. The insert tool can also be used for this process. Place the cursor in the Editor window at the place where the initialization sequence should be added. Compile the program and then call the insert tool. Press [Initializing Sequence]. An initialization block is created for each structure variable that has been declared.

Inserting an instruction:



493929483

14.9 User-defined structures

Users can define their own structures in addition to the SEW standard structures. First of all, the structure must be created. This is done in the declaration part of the program. The 'typedef struct' keyword is used for this. This can be explained by taking an example which creates a position table.

```
// Define user structure
typedef struct
{
 long pos1;
 long pos2;
 long pos3;
 long pos4;
 long pos5;
} table;
```

This creates a structure with the name `table`. You can now use this structure as explained for the standard structures. The next step is to declare a variable as the structure variable.

```
// Declare structuretable postable;
```

Now the variable PosTable has been declared as a structure variable of the structure type `table`. The next step is to access the elements. The table must be initialized to do so.

```
// Initiate
postable.pos1 = 100000;
postable.pos2 = 120000;
postable.pos3 = 50000;
postable.pos4 = 200000;
postable.pos5 = 10000;
```

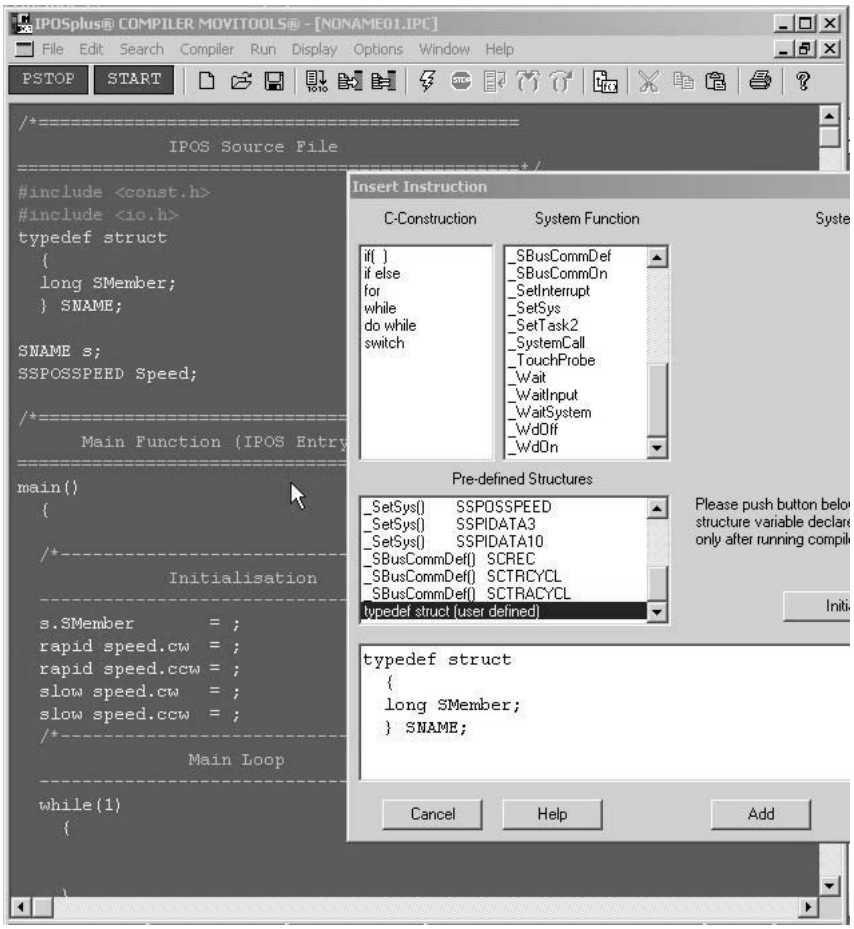
The following is a general description of the procedure for setting up a user structure:

```
typedef struct
{
 Type Identifier1;
 Type Identifier2;
 ...
 Type IdentifierN;
} Structure name;

StructureName VariableName;

VariableName.Identifier1 = ...;
VariableName.Identifier2 = ...;

VariableName.IdentifierN = ...;
```

The insert tool can also be used for user-defined structures. To do so, from the Pre-defined Structures window of the insert help choose 'typedef struct (user defined)'. Now you can change the name of the elements and the structure.

Once you have inserted the structure, a declaration line is added to the Editor window that declares the structure variables of this structure type. This line must still be edited in the Editor. Additional elements can be added within the structure type in the same way. Once the entries have been compiled, an initialization sequence can be activated using the insert tool. Before doing so, the cursor must be positioned in the Editor at the place where the initialization sequence is to be inserted.

Structures:



493933835

14.10 long

As an alternative to assigning variables using #define, the key word long can be used to declare an individual variable. In this case, the variable number is assigned by the Compiler during compilation.

The key word long initiates a declaration of one or more global variables. The following example shows how to use the key word.

The syntax of a declaration of one or more global variables is as follows:

```
long Identifier1 [, Identifier n] ;
```

Example:

```
long setpoint,actual_value;
```

During compilation, the symbolic variables setpoint and actual value are assigned an IPOS$^{plus®}$ variable. The user always accesses the variable by using the symbolic name.

14.11 initial long

'initial long' is available as another key word. 'initial long' declares a variable that is then stored in the variable range from H0 to H127 during compiling. This means the variable is stored in the variable range that is not lost when there is a power failure.

Example:

```
initial long start position, end position;
```

INFORMATION

The legibility of the program text is significantly enhanced if all constants are written in capitals (e.g. SECOND, MAXIMUM, etc.) and variables are written in upper/lower case (e.g. SpeedSetpoint, PositionCW, etc.).

14.12 #pragma

The #pragma directive can be used to influence the variable range occupied by the key words 'long' and 'initial long'.

```
Syntax: #pragma  Directive  Parameter1  Parameter2 ...
```

The Compiler supports the following #pragma directives:

#pragma list	Causes the source text lines to be included in the resulting IPOS$^{plus®}$ program as comments.
#pragma var Hmin Hmax	Instructs the Compiler to use IPOS$^{plus®}$ variables Hmin through Hmax as auxiliary variables for calculating expressions. Hmax must be greater than Hmin. An error message is output if the programmer uses the same variables in the program. Experience shows that the Compiler needs about 10 auxiliary variables. The Compiler uses variables H400 through H419 if this directive is not specified explicitly.
#pragma globals Hmin Hmax	Instructs the Compiler to assign a variable number from the variable range Hmin to Hmax to the variables declared with the long key word. The user is responsible for avoiding overlaps when linking variable names with symbols using #define. The Compiler uses variables H420 through H449 if this directive is not specified explicitly.
#pragma initials Hmin Hmax	Instructs the Compiler to assign the numbers Hmin through Hmax to the global variables declared with the initial key word. Initial variables are variables H0 to H127 which are stored when the power is switched off. Exception: H0 to H15 for MDS, MDV, MCS, MCV with cam disk. The Compiler uses variables H0 to H127 if this directive is not explicitly specified.

INFORMATION

Since the variable range H360 to H450 for the technology options "Synchronous" operation and "Cam Disk" is assigned other system variables, we recommend that you always assign the auxiliary and global variables with the #pragma directive in a different range.

Example:

```
#pragma var 350 365
#pragma globals 130 160
#pragma initials 10 30

long pos speed cw, pos speed ccw;
initial long start position, end position;
```

These lines cause the Compiler to use the IPOS$^{plus®}$ variables from H350 onwards as auxiliary variables. The variables PosSpeedCW and PosSpeedCCW that are declared with the 'long' key word are now stored in the IPOS$^{plus®}$ variables between H130 and H160 because of the #pragma globals 130 160 command line. The variables StartPosition and EndPosition that are declared with the 'initial long' key word are now stored in the IPOS$^{plus®}$ variables between H10 and H30 because of the #pragma initials 10 30 command line. Since they are therefore also in the variable range from H0 to H127, these variables can also be stored in the non-volatile memory.

INFORMATION

The **variable numbers** are used **without** the preceding letter **H** when they are used within the #pragma directives.

14.13 Explanation of const.h and io.h / constb.h and iob.h

The const.h header file defines many useful identifiers. As far as beginners are concerned, only the symbolic names of the system variables are of importance initially. The other identifiers are important for expert users who no longer use the insert tool. This section contains the definitions of arguments for calling the standard functions.

Both the header file io.h and the file const.h are predefined files that cannot be changed. The file is printed out below:

```
/*============================================
File name: Io.h
File version: 2.01

Definition of bitmasks for digital in- and outputs

Please do not modify this file!

(C) 1999 SEW-EURODRIVE
============================================*/

#ifndef _IO_H
#define _IO_H

#define DI00 (H483 & 0b1)
#define DI01 (H483 & 0b10)
#define DI02 (H483 & 0b100)
#define DI03 (H483 & 0b1000)
#define DI04 (H483 & 0b10000)
#define DI05 (H483 & 0b100000)
#define DI10 (H483 & 0b1000000)
#define DI11 (H483 & 0b10000000)
#define DI12 (H483 & 0b100000000)
#define DI13 (H483 & 0b1000000000)
#define DI14 (H483 & 0b10000000000)
#define DI15 (H483 & 0b100000000000)
#define DI16 (H483 & 0b1000000000000)
#define DI17 (H483 & 0b10000000000000)

#define DB00 (H482 & 0b1)
#define DO01 (H482 & 0b10)
#define DO02 (H482 & 0b100)
#define DO10 (H482 & 0b1000)
#define DO11 (H482 & 0b10000)
#define DO12 (H482 & 0b100000)
#define DO13 (H482 & 0b1000000)
#define DO14 (H482 & 0b10000000)
#define DO15 (H482 & 0b100000000)
#define DO16 (H482 & 0b1000000000)
#define DO17 (H482 & 0b10000000000)

#endif
```

The io.h header file defines macros that make it easier to query terminal levels. The following example illustrates this point.

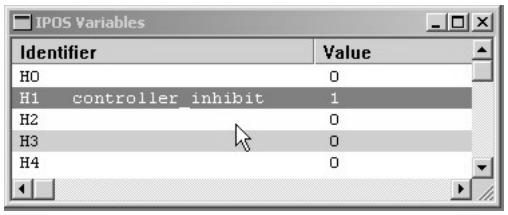
```
if( DI00 )
{
 H1 = 1;  // execute command block, if terminal DI00 has NOT level 0
}
else
{
 H1 = 0;  // execute command block, if terminal DI00 has level 0
}
```

The if statement queries terminal DI00, the /CONTROLLER INHIBIT terminal. If the argument of the if statement is zero, then the statements in the else part are processed (assuming there is an else part). In this case, IPOS$^{plus®}$ variable H1 is set to zero or one depending on the input level of terminal DI00. Note that it is impossible to query when the terminal is set to 1 (DI00 == 1) because the macro supplies a binary evaluation. In practical terms, it is possible to query for zero (DI00 == 0) or not equal to zero (DI00 != 0).

This program extract can be made clearer using the commands which have already been explained. This is done by introducing additional symbolic identifiers.

```
#define controller_inhibit    H1
#define HI 1
#define LO 0

if( DI00 )
{
 controller_inhibit = 1;  // execute command block, if terminal DI00 has NOT
         //level 0
}
else
{
 controller_inhibit = 0;  // execute command block, if terminal DI00 has
         //level 0
}
```

The following appears in the variable window:



499400587

INFORMATION

Note that the io.h header file must be linked using the #include io.h command line before it can be used.

14.14 Identifiers

Although we have already used identifiers several times, this section provides additional information about them. An identifier is understood to be the name that can be adopted by a Macro identifier (Define section), a symbolic variable name or a function name. Only letters, numbers and an underscore can be used in an identifier, and the identifier must start with a letter or an underscore.

An identifier can be up to 32 characters in length.

The following identifiers are valid:	The following names are not identifiers:
TerminalX13_4 Setpoint1 _Control_word	TerminalX13.4 Setpoint 1 1st setpoint 1_Input My function ThisIdentifierNameIsMuchTooLong

INFORMATION

The IPOS$^{plus®}$ Compiler is case-sensitive.

14.15 Constants

The IPOS$^{plus®}$ Compiler supports various types of constants which are differentiated in the source text by their specific notation. Representation in different formats can improve the legibility of the source text depending on how they are used.

The formats decimal, hexadecimal or binary are possible forms of representation.

Hexadecimal constants start with the '0x' string, binary constants with the '0b' string. Here are a few examples:

Decimal constants	Hexadecimal constants		Binary constants	
123	0x23	=35 dec	0b000100	= 4 dec
-50	0xabc	= 2748 dec	0b10	= 2 dec
030	0xFFFFFFFF	= -1 dec	0b11111111	= 255 dec

14.16 IPOS$^{plus®}$ variables in the Compiler

The IPOS$^{plus®}$ variables are practically an element of the language and are not allowed to be declared explicitly. They all have the same data type (32 bit with sign) and are valid globally throughout the entire source text. The following line is present implicitly in each module:

```
long H0, H1, H2, H3, ... , H1023.
```

To identify variables symbolically, the #define or #declare directives can be used to define a symbolic name.

14.16.1 Example

```
#define TESTVAR1 H73 //H73 has the symbolic name "TESTVAR1"
```

H73 is then assigned the value 134 in the program from one of 3 assignments:

```
TESTVAR1 = 134;
TESTVAR1 = 0x86;
TESTVAR1 = 0b10000110;
```

14.17 Declaration of global variables

Another option is to declare global variables with the long key word as already explained above. The Compiler then automatically defines the numbers of the variables (see #pragma). The variable numbers are assigned in ascending order according to where the variable declarations occur in the source text. A declaration starts with the key word long, followed by the list of symbolic identifiers separated by commas. The declaration ends with a semicolon. The declaration can be spread over several source text lines.

A global variable can be declared anywhere in the program, provided it is outside of blocks (generally functions). For reasons of clarity, variables should be declared at the start of the source text module. A global variable must also be declared before it is used.

Examples:

```
long a, b;            // Variables are available in the range
long this_is_a_variable;// defined for global variables
long c, d;
```

The Compiler assigns variables H420 to H424 to the identifiers a, b, this_is_a_variable, c and d. In the following example, the '#pragma globals' directive instructs the Compiler to assign variables H150 to H160 to the identifiers.

```
#pragma globals 150 160
long a, b;
long this_is_a_variable;
long c, d;
```

	INFORMATION
	Multiple declarations of global variables are **not allowed**:
	`long a, b, c;`
	`long d, a;`

It is a good idea to use the option of defining global variables when the number of the variable is not important for the application. This is usually the case because the variables are accessed continually by symbols. Furthermore, global variable declaration underlines the modularity and makes it easier to reuse modules. Standard or user-defined structures can be used as a recourse if variable groups are required, e.g. for system functions.

For a description of the system variables H473 to H511, refer to the section "Overview of the System Variables". A list of system variables and their symbolic identifiers is given in the appendix.

14.18 Indirect addressing – pointer

The designations *H0 to *H511 are also allowed as variable names in order to make use of the possibility of accessing variables indirectly (SET [H] = H) from IPOS$^{plus®}$. These names can be used on both the right and left sides of assignments or in expressions, such as H0 to H511. In this case, however, the Compiler inserts the indirect commands.

Example for using indirect variables:

```
H2 = 5;
H3 = 6;


H5 = 7;
H6 = 3;


H1 = *H2 + *H3;
```

Variable H1 is assigned the value 10 because the value 7 is accessed indirectly via *H2 (see H5) and the value 3 is accessed indirectly via *H3 (see H6).

14.19 numof()

The key word numof() returns the number of a variable. The identifier of a direct or symbolic variable is given as the argument. The argument is not allowed to be a composite expression.

```
#define setpoint H200
#declare setpoint2 setpoint:1

H1 = numof(H7);
H2 = numof (setpoint);
H3 = numof (setpoint2);
```

These program lines supply the IPOS$^{plus®}$ variables with the following values:

```
H1 = 7
H2 = 200
H3 = 201
```

INFORMATION

The following program lines are **not permitted**:

```
#define Setpoint H10+H30
#define Var1     H200

H1 = numof(*H1);
H1 = numof(H1 + H4);
H1 = numof(H3 + 6);
H1 = numof(Setpoint);
H1 = numof(Var1:1);
```

15 Compiler – Operators

Operators are used to link identifiers to one another and to statements in order to perform certain operations. The IPOS$^{plus®}$ Compiler provides operators for performing arithmetical operations, bit operations, assignment operations or comparison operations.

Operators are divided into various categories and have a specified order of priority. The order of priority determines the order in which the operators are executed within a statement. The following table lists all the operators supported by the IPOS$^{plus®}$ Compiler by order of priority.

15.1 Order of priority of operators

Category	Operator	Description
1.	()	Brackets
2. Unary	! ~ + - ++ --	Logical negation (NOT) bit-by-bit complement Unary plus Unary minus Pre or post-incrementing Pre or post-decrementing
3. Multiplicative	* / %	Multiplication Integer division Modulo remainder
4. Additive	+ -	Binary plus Binary minus
5. Shift	<< > >	Shift left Shift right
6. Relational	< <= > > =	Less than Less than or equal to Greater than Greater than or equal to
7. Equality	== !=	Equal to Not equal to
8.	&	Bit-by-bit AND
9.	^	Bit-by-bit XOR
10.	¦	Bit-by-bit OR
11.	&&	Logical AND
12.	¦¦	Logical OR
13. Conditional	? :	Ternary operators, see section "Ternary Operators"
14. Assignment	= *= /= %= += -= &= ^= ¦= <<= > > =	Simple assignment Assign product Assign quotient Assign remainder Assign sum Assign difference Assign bit-by-bit AND Assign bit-by-bit XOR Assign bit-by-bit OR Assign shift left Assign shift right
15. Comma	,	Evaluate

Category 1 has the highest priority, category 2 (unary operators) has the second highest priority, etc. The comma operator has the lowest priority.

Operators in the same category have the same ranking.

The unary operators (category 2), conditional operators (category 13) and assignment operators (category 14) assign from right to left; all others assign from left to right.

The operator for multiplication (*) is ranked before the operator for addition (+), so multiplication is performed before addition in the following statement:

```
H1 = 3 * 7 + 2 * 4;
```

H1 is assigned the value 29.

Brackets have to be used if the addition is to be performed before the multiplication:

```
H1 = 3 * ( 7 + 2 ) * 4;
```

H1 is assigned the value 108 (from 3 * 9 * 4).

INFORMATION

The sequence can be forced by brackets to ensure the sequence of operations is as you require it. Nested brackets are permitted. Superfluous brackets have no effect on the program function.

15.2 Unary operators

Unary operators are operators positioned before or after an operand and only influence this operand.

```
H1 = -H2;   // The unary minus operator (-) forms the value of H2 with a changed sign
H1 = ~H2;   // The unary complement operator (~) forms the bit-by-bit complement of H2
++H3 //, the pre-increment operator (++) increases the value of H3 by one
```

15.3 Binary operators

These operators link two operands together and are located between two operands.

15.3.1 Example

```
H1 = H2;    // The binary assignment operator (=) assigns variable H1 the value of H2
H1 = H2 - 3;    // The binary minus operator (-) forms the difference between H2 and 3
```

Combined assignment operators lead to an abbreviated notation. Although they make it more difficult to read a program, they are mentioned for the sake of completeness. The operation is performed in the example with H1 = 2 (0b10) and H2 =3 (0b11).

Operator	Operation	Example	Corresponds to	Example H1 =
=	Simple assignment	H1 = H2;	H1 = H2;	3
*=	Assign product	H1 *= H2;	H1 = H1 * H2;	6
/=	Assign quotient	H1 /= H2;	H1 = H1/H2;	0
%=	Assign remainder	H1%= H2:	H1 = H1% H2;	2
+=	Assign sum	H1 += H2;	H1 = H1 + H2;	5
-=	Assign difference	H1 -= H2;	H1 = H1 - H2;	-1
&=	Assign bit-by-bit AND	H1 &= H2;	H1 = H1 & H2;	0b10
^=	Assign bit-by-bit XOR	H1 ^= H2;	H1 = H1 ^ H2;	0b01
¦=	Assign bit-by-bit OR	H1 ¦= H2;	H1 = H1 ¦ H2;	0b11
<<=	Assign shift left	H1 <<= H2;	H1 = H1 << H2;	0b1000
> > =	Assign arithmetical shift right	H1 >>= H2;	H1 = H1 >> H2;	0b0

15.4 Ternary operators

The IPOS$^{plus®}$ Compiler only recognizes one operator that links together three operands: The conditional operator. Its form is as follows:

a ? b : c means: If a then b, otherwise c

where a is a logical expression and b and c are expressions.

15.4.1 Example

```
H1 = H2 == 3 ? H3 : H4;        //  If H2 equals 3, H1 is assigned the value of
H3,
        // otherwise it is assigned the value H4
```

The example is the abbreviated notation of:

```
if (H2 == 3)
 H1 = H3;
else
 H1 = H4;
```

Where possible, the ternary operator should not be used due to the illegibility of the source code.

16 Compiler – Constructions

The IPOS$^{plus®}$ Compiler provides constructions that are also available in other high-level languages.

The following constructions are available:

- if...else
- for
- while
- do...while
- switch...case...default

These are supplemented by statements such as 'continue' and 'break', which are used as control elements within these constructions.

16.1 if...else

16.1.1 Syntax

```
if ( expression )// Instructionelse// Instruction
```

The key words if and else control the program flow depending on whether the expression following the key word if returns the value TRUE (not equal to zero) or FALSE (equal to zero). The else branch is optional. It is performed if the expression returns the value FALSE. In a special case, a statement can also be a block in which several statements can be specified. In this case, the statement block must be enclosed by curly brackets ({statement block}).

Without else branch	With else branch	With block as if branch	With block as else branch

`if ( H1 == 3 )`
`  H2 = 10;`
	`if ( H1 == 3 )`
	`  H2 = 10;`
	`else`
	`  H2 = 8;`
		`if ( H1 > 3 )`
		`{`
		`  H2 = 10;`
		`  H3 = 11;`
		`}`
			`if ( H1 > 3 )`
			`  H2 = 9;`
			`else`
			`{`
			`  H2 = 10;`
			`  H3 = 11;`
			`}`

The expression may also be composed of several conditions which are logically interlinked. Consequently, logical AND (&&) and logical OR (¦¦) are available as logic operations.

INFORMATION

Potential problem: A ; (semicolon) at the end of an if statement always makes the condition true.

Example

```
if ( ( H1 >= 3 ) && ( H1 <= 12 ) )
  H2 = 10;
```

Variable H2 is set to the value 10 if H1 is greater than or equal to 3 and is also less than or equal to 12. In other words: H2 is set to the value 10 if the value of H1 is between 3 and 12.

The internal brackets are not necessary, but they increase the legibility of the program.

Example

```
if ( H1 < 2 || H1 > 14 )
 H2 = 10;
```

Variable H2 is set to the value 10 if H1 is less than 2 or greater than 14. In other words: H2 is set to the value 10 if the value of H1 is not between 2 and 14.

16.2 for

16.2.1 Syntax

```
for ( Expression1 ; Expression2 ; Expression3 )
// Statement
```

The for statement can be used to construct program loops that should be exited after a specified number of repetitions. The meanings of the three expressions are as follows:

Expression1 is executed once at the start of the for loop. This is where the run variables are initialized. Expression2 determines when the loop is broken off. The loop is broken off if the expression returns the logical value FALSE (or equal to zero). Expression3 is processed after the statement has been executed. As a rule, it is used for altering the run variables. The statement forms the body of the loop which may consist of one statement or a statement block.

Example

```
H1 = 20;
for ( H0 = 0; H0 < 10; ++H0 )
 H1 = H1 + 2;
```

H0 is set to zero at the start. Then a check is performed to see whether H0 has reached the value 10. If this is not the case, then the statement is processed. In this example, therefore, H1 is increased by 2. The run variable H0 is then increased by one. Next, the check whether H0 has reached the value 10 is repeated, etc.

At the end of the loop, the value of H0 is 10 and that of H1 is 40 because the loop is performed 10 times (loop counter H0 runs from 0 to 9 and then is canceled).

Example of a statement block

```
H1 = 20;
H2 = 0;
for ( H0 = 0; H0 < 10; ++H0 )
{
 H1 = H1 + 2;
 ++H2;
}
```

Whereas variable H1 is increased by 2 each time the loop runs through, variable H2 is only increased by 1 (++H2 means pre-increment).

If a continue statement is processed within the statement block, this means the program jumps to the end of the statement block and then processes expression3, which triggers a check to determine whether the condition in the for statement is performed for a new loop cycle.

Example

```
H1 = 20;
H2 = 0;
for ( H0 = 0; H0 < 10; ++H0 )
{
 H1 = H1 + 2;
 if ( H1 > 32 )
  continue;
 ++H2;
}
```

The if query with the continue statement means variable H2 is no longer incremented as soon as H1 is greater than 32. This means when the loop is finished, the value of variable H1 is 40 and that of H2 is 6.

If a break statement is processed in the statement block, this means the program exits the for loop at that point. The loop is no longer continued.

Example

```
H1 = 20;
H2 = 0;
for ( H0 = 0; H0 < 10; ++H0 )
{
 H1 = H1 + 2;
 if ( H1 > 32 )
  break;
 ++H2;
}
```

The if query with the break statement means that the loop is exited as soon as H1 is greater than 32. This means that when the loop is exited, the value of variable H1 is 34 and that of H2 is 6.

16.3 while

16.3.1 Syntax

```
: while ( expression )
// Statement
```

The while statement is a conditional loop which performs the statement for as long as the value of the expression is TRUE (not equal to zero). The statement is never performed if the expression never has the value TRUE. The expression is always processed before the statement.

The statement can also be a statement block in which several statements can be specified.

The expression can also be made up of several logically interlinked conditions.

Example

```
H2 = 0;
H1 = 10;
while ( H1 > 5 )
{
 H2 = H2 + 1;
 --H1;
}
```

The statements within the block are carried out as long as H1 is greater than 5. H2 gets the value 5 when the loop breaks off.

As in the for loop, it is also possible to use the break and continue statements here. The break statement once again causes the while loop to be exited. The continue statement results in a jump to the end of the statement block followed by repeating the check of the expression to see whether the loop will be processed again.

Example

```
H1 = 0;
while ( H1 < 20 )
{
 ++H1;
 if ( H1 > 10 )
  continue;
 H2 = H2 + 2;
}
```

As long as H1 is less than or equal to 10, H2 is increased by 2. If the value of H1 is greater than 10, processing jumps to the end of the while loop at which point the condition for running through the loop again is tested. H2 is not changed any further during addition loop cycles. If the value of H1 is 20, the loop is exited.

Example

```
H1 = 0;
while(1)
{
 ++H1;
 if ( H1 == 20 )
  break;
 if ( H1 > 10 )
  continue;
 H2 = H2 + 2;
}
```

This example has the same effect as the one shown previously. The "endless" loop is left using the break statement if H1 equals 20.

This is an endless loop, which can be created using the following construction:

```
while(1)
// Statement
```

This is because expression 1 always returns the value TRUE.

Task1 typically runs in an endless loop of this kind.

16.4 do...while

16.4.1 Syntax

```
do
// Loop statement
while ( Expression );
```

The do statement is a conditional loop in which the break condition is checked at the end of the loop. As a result, this loop with the do statement always performs at least one iteration (at least one run-through).

First, the statement is performed. As a statement block, it may also contain several statements. This is followed by the test of whether the expression has the value TRUE (not equal to zero) or FALSE (equal to zero). If the value is TRUE, the statement is performed again, otherwise the loop is exited.

The expression can also be made up of several logically interlinked conditions.

In contrast to the while loop, the statement is always performed at least once in the do while loop.

	INFORMATION Potential problem: The while (...); line always ends with a semicolon.

Example

```
H2 = 0;
H1 = 10;
do
{
 H2 = H2 +1;
 H1 = H1 -1;
} while ( H1 >  5 );
```

The statements within the block are carried out as long as H1 is greater than 5. H2 gets the value 4 when the loop breaks off.

If the expression always remains TRUE, the result is an endless loop:

```
do
 H2 = H2 +3;
while ( 1 );
```

In this case, the expression has the value 1, which means that the loop is never broken.

This loop can be broken off using the break statement.

```
H2 = 0;
do
{
 H2 = H2 +3;
 if ( H2 > 20 )
  break;
} while ( 1 );
```

In this example, the do loop is broken off using the break statement if the value of the IPOS$^{plus®}$ variable H2 is greater than 20.

A continue statement is also possible. It causes the program to skip to the end of the statement block and then to check the expression.

```
H2 = 0;
do
{
 H2 = H2 +3;
 if ( H2 > 20 )
  break;
 if ( H2 > 10 )
  continue;
 ++H0;
} while ( 1 );
```

In this example, the incrementation of the IPOS$^{plus®}$ variable H0 stops as soon as the value of the IPOS$^{plus®}$ variable H2 is greater than 10.

16.5 switch...case...default

16.5.1 Syntax

```
switch ( Expression )
{
 case Wert 1:// statement 1
  break;
 case Wert 2:// statement 2
  break;
  .
  .
 default:// Statement n
}
```

The switch statement makes it possible to create multiple program branches depending on the value of an expression.

If Expression has the value 1, Statement 1 is performed, if Expression has the value 2, Statement 2 is performed, etc. If none of the values following 'case' corresponds with 'Expression,' the default statement – if programmed – is executed (Statement n).

INFORMATION

Statements 1, 2,..., n are normally sequences of statements which end with a break statement. If the sequence of statements does not end with a break statement, all subsequent case branches are performed until a break statement is encountered. The value is then no longer compared with the expression.

Statements 1, 2,..., n can also be function calls. For example, a jump distributor can be set up.

Value 1, Value 2, Value n must be constants or constant expressions. No variables are permitted here.

The default branch must – if available – be the last line in a switch statement.

```
switch ( H1 )
{
case 1: ++H2;
  break;
 case 2: ++H3;
  break;
default: ++H4;
  break;
}
```

This program extract increments IPOS$^{plus®}$ variable H2 if the value of IPOS$^{plus®}$ variable H1 is 1. If its value is 2, then the IPOS$^{plus®}$ variable H3 is incremented. IPOS$^{plus®}$ variable H1 is incremented given any other value of IPOS$^{plus®}$ variable H4.

The following variant is also possible:

```
switch ( H1 )
{
 case 1:
case 2: ++H3;
  break;
default: ++H4;
  break;
}
```

This program extract increments IPOS$^{plus®}$ variable H3 if the value of IPOS$^{plus®}$ variable H1 is 1 or 2. IPOS$^{plus®}$ variable H1 is incremented given any other value of IPOS$^{plus®}$ variable H4.

16.6 return

The key word `return` ends the processing of a function and returns to the command following the function call. The `return` statement makes it possible to end functions prematurely, for example, to increase the clarity of a C program. However, using this statement too often can have the opposite effect. The following applies: a function should contain as few exit points as possible.

The following example shows two coding possibilities for achieving the same result. The example on the left uses the `return` statement to exit the function prematurely, whereas the example on the right does not use `return`.

```
Function ()
{
 // Leave function when H1 is 5
 if ( H1 == 5 )
  return;
 H2=3;
}
```

```
Function ()
{
 // Skip statement when H1 = 5
 if (H1 != 5)
 {
  H2=3;
 }
}
```

17 Compiler – Functions

17.1 User-defined functions

The user can program functions (subprograms). Used-defined functions cannot be called when function arguments are transferred. However, this is also unnecessary because all variables are global and cannot be encapsulated with local variables. The structure of a function is as follows:

```
FunctionName()
{
 // Statements
}
```

The function prototypes in the program header do not have to be defined, in contrast to ANSI-C.

Once the function has been performed, the line following the function call is processed.

A function can be exited prematurely using the return statement. In this case, program processing is continued with the line following the function call.

Using the return statement can increase the clarity of a program structure. However, using this statement too often can have the opposite effect. The following applies: a function should contain as few exit points as possible.

```
SampleFunction()
{
 // Leave function when H1 is 5
 if ( H1 == 5 )
  return;
 H2=3;
}
```

INFORMATION

A user-defined function cannot be called from several tasks.

17.2 Overview of commands for standard functions

A large part of the IPOS$^{plus®}$ machine commands that are familiar from the IPOS$^{plus®}$ Assembler language are reproduced in the IPOS$^{plus®}$ Compiler's high-level language in the form of certain syntactical constructions. For example, arithmetic commands (ADD, SUB, etc.) are created by appropriate operators (+, -, etc.) or set commands (SET...) are replaced by the assignment operator (=). However, there are also commands with no equivalent in the programming language. These commands (GOA, BSET, etc.) are reproduced using functions that form part of the Compiler and are therefore described as standard functions, in contrast to user-defined functions.

The parameters of the IPOS$^{plus®}$ machine commands become function arguments of the standard functions. The names of all standard functions start with an underscore (_) so it is easier to distinguish them from user functions in the source text.

The constants specified as an argument in many functions are defined in the header file CONSTB.H (MOVIDRIVE® B). If you want to use your own names instead, you can define them using the #define directive.

The following tables list the standard functions and the unit-specific availability.

17.2.1 Standard bit functions

Command	Function	Availability			Reference
		MOVIDRIVE® B	MOVITRAC® B	MQx	
_BitClear	Deletes a bit within a variable	X	X	X	(page 209)
_BitMove	Copies a bit in one variable to a bit in another variable.	X	X	X	(page 209)
_BitMoveNeg	Copies a bit in one variable to a bit in another variable and negates it.	X	X	X	(page 209)
_BitSet	Sets a bit within a variable	X	X	X	(page 210)

17.2.2 Standard communication functions

Command	Function	Availability			Reference
		MOVIDRIVE® B	MOVITRAC® B	MQx	
_MoviLink	Process and/or parameter data exchange via RS-485 or system bus.	observe the unit-specific command structure			(page 222)
_MovCommDef	Process data transfer via RS-485 (Especially with MQx MOVIMOT®).	-	-	X	(page 227)
_MovCommOn	Start of process data transfer via RS-485.	-	-	X	(page 229)
_SBusCommDef	Definition of process data exchange via system bus.	X	X	-	(page 230)
_SBusCommOn	Start of process data transfer via system bus.	X	X	-	(page 234)
_SBusCommState	Start of process data transfer via system bus.	X	(X)	-	(page 234)

17.2.3 Standard positioning functions

Command	Function	Availability			Reference
		MOVIDRIVE® B	MOVITRAC® B	MQx	
_Go0	Performs reference travel	X	-	-	(page 217)
_GoAbs	Absolute positioning	X	-	-	(page 218)
_GoRel	Relative positioning	X	-	-	(page 219)

17.2.4 Standard program functions

Command	Function	Availability			Reference
		MOVIDRIVE® B	MOVITRAC® B	MQx	
_InputCall	Calls a defined function when specific selected bits are set or deleted at the input terminals.	X	X	X	(page 220)
_Nop	No operation	X	X	X	(page 229)
_SystemCall	Calls a defined function when the system even occurs.	X	X	-	(page 241)
_SetTask	Defines a function as task 2 or task 3 and starts or stops it.	X	only for task 2	-	(page 238)
_SetTask2	Defines a function as task 2 and starts or stops it.	X	X	X	(page 239)
_Wait	Waits for a specified period	X	X	X	(page 243)
_WaitInput	Waits until a certain level is present at certain input terminals.	X	X	X	(page 243)
_WaitSystem	Waits until a system event occurs.	X	X	-	(page 244)

17.2.5 Standard setting functions

Command	Function	Availability			Reference
		MOVIDRIVE® B	MOVITRAC® B	MQx	
_Copy	Block-by-block, consistent copying of variables.	X	X	X	(page 210)
_GetSys	Reads an internal system value.	observe the unit-specific command structure			(page 211)
_SetInterrupt	Defines a function as interrupt routine and activates or deactivates it.	X	X	X	(page 235)
_SetVarInterrupt	Defines a function as variable routine and activates or deactivates it (only MOVIDRIVE® B).	X	-	-	(page 240)
_SetSys	Sets an internal system value.	observe the unit-specific command structure			(page 236)

17.2.6 Special standard unit functions

Command	Function	Availability			Reference
		MOVIDRIVE® B	MOVITRAC® B	MQx	
_AxisStop	The drive is stopped.	X	-	-	(page 208)
_FaultReaction	Sets the fault response to a selected fault.	X	X	-	(page 210)
_Memorize	Saves or loads variables or IPOS$^{plus®}$ program.	X	X	X	(page 221)
_TouchProbe	Enables or locks a touch probe input.	X	-	X	(page 242)
_WdOn	Sets the Watchdog timer to a specific value.	X	X	X	(page 245)
_WdOff	Turns the Watchdog off.	X	X	X	(page 244)

17.3 Standard functions

This chapter lists the standard functions in alphabetical order. This makes it easier to find the standard function you are looking for.

17.3.1 _AxisStop

Syntax

```
_AxisStop( typ )
```

Description

The drive axis is stopped when the IPOS$^{plus®}$ control word is written. A restart must be carried out by the enable function via the IPOS$^{plus®}$ control word. The argument can be used to specify the type of axis stop, or the deactivation of the lock can be specified via the IPOS$^{plus®}$ control word.

Argument

type

AS_RSTOP	Braking with the P136 rapid stop ramp, followed by the status "No enable". The last target position (H492) to have been transmitted is retained. Inhibit via control word (command ASTOP (IPOS ENABLE) is required before the subsequent travel command). The brake is applied if the brake function is activated. The message "In position" is set.
AS_HCTRL	Braking with the ramp of the basic unit P131/P133 followed by position control. The last target position to have been transmitted is retained. Inhibit via control word (the ASTOP (IPOS ENABLE) command is required before the subsequent travel command). The brake is **not** applied if the brake function is activated.
AS_PSTOP	Positioning stop with positioning ramp P911/P912 and calculated "STOP" target position (only possible in the positioning mode), followed by position control. The last target position (H492) to have been transmitted is overwritten by the stop position. No inhibit via control word (no ASTOP (IPOS ENABLE) command required before the subsequent travel command). The brake is **not** applied if the brake function is activated. Note: Since the actual position is used as the setpoint position at standstill, the command cannot be processed cyclically. This is the case in axes with process forces or hoists because otherwise the axis drifts slowly out of position. **Note: "AS_PSTOP" is not completed in the event of a fault. The program stops.**
AS_ENABLE	The inhibit is revoked using the IPOS$^{plus®}$ control word.

INFORMATION

Since the actual position is used as the setpoint position at standstill, the argument AS_PSTOP cannot be processed cyclically. This is the case in axes with process forces or hoists because otherwise the axis drifts slowly out of position.

Example

```
main()
{
 _GoAbs( GO_NOWAIT,3000 ); // Start movement job
 _AxisStop( AS_PSTOP ); // Cancel movement
              // Statements during standstill
 _AxisStop( AS_ENABLE ); // Revoke inhibit
 _GoAbs( GO_NOWAIT,3000 ); // Send new movement job
}
```

17.3.2 _BitClear

Syntax

```
_BitClear( H, bit )
```

Description

_BitClear sets the bit within variable H to zero.

Key points

H Variable name

bit Constant expression for bit position

Example

```
main()
{
 _BitClear( H100, 3 ); // deletes bit 3 in H100
}
```

17.3.3 _BitMove

Syntax

```
_BitMove( H2 , bit2, H1, bit1 )
```

Description

Copies the bit with the number bit1 in IPOS$^{plus®}$ variable H1 to the bit with the number bit2 in IPOS$^{plus®}$ variable h2. All bits of H1 and all other bits of H2 remain unchanged. The bit positions of a variable are numbered 0 to 31. The least significant bit has the number 0.

Key points

h2 Name of the target variable

bit2 Number of the target bit

h1 Name of the source variable

bit1 Number of the source bit

Example

```
main()
{
 _BitMove( H1, 3,H2, 4 ); // copies H1.3 = H2.4
 _BitMove( H1, 1,H1, 0 ); // copies H1.1 = H1.0
}
```

17.3.4 _BitMoveNeg

Syntax

```
_BitMoveNeg( H2 , bit2, H1, bit1 )
```

Description

Copies the bit with the number bit1 in IPOS$^{plus®}$ variable H1 to the bit with the number bit2 in IPOS$^{plus®}$ variable H2. The bit is negated during this process. All bits of H1 and all other bits of H2 remain unchanged. The bit positions of a variable are numbered 0 to 31. The least significant bit has the number 0.

Key points

h2 Name of the target variable

bit2 Number of the target bit

h1 Name of the source variable

bit1 Number of the source bit

Example

```
main()
{
 _BitMoveNeg( H1, 3,H2, 4 ); // copies H1.3 = NOT (H2.4)
 _BitMoveNeg( H1, 1,H1, 0 ); // copies H1.1 = NOT (H1.0)
}
```

17.3.5 _BitSet

Syntax

```
_BitSet( H, bit )
```

Description

Within the IPOS$^{plus®}$ variable h, _BitSet sets the bit with the number bit to one.

Key points

H Variable name

bit Constant expression with the number of the bit to be set

Example

```
main()
{
 _BitSet( H100, 3 ); // sets bit 3 in H100
}
```

17.3.6 _Copy

Syntax

```
_Copy( H2 , H1, no.)
```

Description

Copies the number (no.) of consecutive variables as a variable block. H1 specifies the name of the first source variable, H2 the name of the first target variable. A maximum of 10 variables can be copied.

Key points

H2 Name of the first target variable

H1 Name of the first source variable

no Constant expression for the number of IPOS$^{plus®}$ variables to copy

Example

```
main()
{
 _Copy( H1,H5, 3 ); // copy H1 = H5, H2 = H6, H3 = H7
}
```

17.3.7 _FaultReaction

Syntax

```
_FaultReaction( fnr, r )
```

Description

This command can be used to program the system response to a unit fault. As such, the command must be carried out before the fault occurs. The argument specifies the fault and the corresponding response if this fault occurs.

All fault responses in the fault list in the operating instructions or the system manual that have a dot in column P can be programmed as fault responses.

Key points

fnr Constant expression for the number of the fault (see list of faults in the operating instructions)

r Constant expression for a fault response that can adopt the following values:

FR_NORESP: No response; error is not displayed.
FR_DISPLAY: Error is only displayed; unit continues to run.
FR_SWOFF_F: Output stage inhibit and unit inhibit. Reset required.
FR_ESTOP_F: Stop via emergency stop ramp with unit inhibit. Reset required.
FR_RSTOP_F: Stop via rapid stop ramp with unit inhibit. Reset required.
FR_SWOFF_W: Output stage inhibit without unit inhibit. Reset re-enables the unit.
FR_ESTOP_W: Stop via emergency stop ramp without unit inhibit. Reset re-enables the unit.
FR_RSTOP_W: Stop via rapid stop ramp without unit inhibit. Reset re-enables the unit.

FR_SWOFF_F / FR_ESTOP_F / FR_RSTOP_F: Unit is reinitialized, i.e. IPOS$^{plus®}$ is re-started.

FR_SWOFF_W / FR_ESTOP_W / FR_STOP_W: Unit is not reinitialized, i.e IPOS$^{plus®}$ continues to run.

Example

```
main()
{
 _FaultReaction( 26,FR_SWOFF_F ); // Emergency stop / Malfunction with
ext. fault
}
```

17.3.8 _GetSys

Syntax

```
_GetSys( H, sys )
```

Description

Loads the value of an internal system value in one or more IPOS$^{plus®}$ variables.

Key points

H Name of the target variable or target structure

sys Expression that designates the system value. sys can adopt one of the following values:

GS_ACTCUR: Active current in 0.1% rated unit current
GS_ACTSPEED: actual speed in 0.1 rpm
GS_SPSPEED: Setpoint speed in 0.1 rpm
GS_ERROR: Error code according to the "Error messages and list of errors" table in the system manual
GS_SYSSTATE: Value of the 7-segment display in accordance with the table "Operating mode display" in the system manual
GS_ACTPOS: Actual position depending on the encoder selected in P941 H509, H510 or H511
GS_SPPOS: Setpoint position H491
GS_TPOS: Target position of the profile generator
GS_INPUTS: Binary inputs H483 (MOVIDRIVE® A) / H520 (MOVIDRIVE® B) of the basic unit and options
GS_SYSSTATE: Identical to status word 1 of the fieldbus unit profile (fault code and operating status)
GS_OUTPUTS: Binary outputs H482 basic unit and options
GS_IxT: Unit utilization in 0.1% rated unit current
GS_ACTPOS / GS_SPPOS / GS_TPOS: Resolution depends on the encoder selected in P941:
– Motor encoder: 4096 Inc./revolution
– External encoder X14: Encoder resolution × P944
– DIP (SSI encoder): Encoder resolution × P955

GS_ANINPUTS: Voltage value / current value of the analog inputs 1 and 2
Voltage input: -10 V ... 0 ... +10 V = -10000 ... 0 ... 10000
Current input: 0 ... 20 mA = 0 ... 5000 / 4 ... 20 mA = 1000 ... 5000
– H + 0 = Analog input 1
– H + 1 = Analog input 2

Only for MOVITRAC® B:

GS_ANINPUTS:
– H + 0 = Analog input 1
– H + 1 = Potentiometer of FBG11B

GS_ANINPUTS3:
– H + 0 = Analog input 1
– H + 1 = Potentiometer of FBG11B
– H + 2 = Analog input 2 (FIO11B option)

The attribute GS_ANINPUTS3 of the command _GetSys generates an "Error 10 IPOS ILLOP" in MOVIDRIVE® B.

GS_CAM: Used to implement a cam controller
– With the GETSYS command, a standard cam controller with 4 outputs can be used per drive. For MOVIDRIVE® units, you can use an expanded cam controller with 8 outputs.
– Hxx is the first variable of a data structure (CamControl or GS_CAM). The bit with the highest significance (bit 31) is used in Hxx to decide which cam controller the GETSYS command refers to.
– Bit 31 = 0: Standard cam controller. The GETSYS command activates the cam controller. The cams are formed once when the GETSYS command is processed. If the cam controller is to work cyclically, the command must be called up cyclically.
– Bit 31 = 1: Extended cam controller with technology option. The GETSYS command activates the cam controller, the cams are formed cyclically in the background.
– For more information on the cam controllers and the data structure, refer to section "Cam controllers" in chapter "Position Detection and Positioning".

GS_ANOUTPUTS: Analog outputs optional, with -10 V ... 0 ... +10 V = -10000 ... 0 ... 10000.
– h = Analog output 1
– h + 1 = Analog output 2

GS_TIMER0: Counter value of TIMER 0 H489 in ms

GS_TIMER1: Counter value of TIMER 1 H488 in ms

GS_PODATA: Reads the PO data buffer. Regardless of the number of PO data items, 2 PO data items or 10 PO data items are read (data sent from the master to the unit).
– H + 0: Bus type
  0 = reserved
  1 = S0 (RS485 #1)
  2 = S1 (RS485 #2)
  3 = Fieldbus
  4 = reserved
  5 = SBus
  8 = SBus 2 (only MOVIDRIVE® B)
– H + 1 = Number of PO data items
– H + 2 = PO1
– H + 3 = PO2
– H + 4 = PO3
– H + 5 = PO4
– H + 6 = PO5
– H + 7 = PO6
– H + 8 = PO7
– H + 9 = PO8
– H + 10 = PO9
– H + 11 = PO10

GS_DCVOLT: DC link voltage [V]

GS_RELTORQUE: Relative torque. The value is available in the operating modes CFC... and SERVO... .

GS_RELTORQUEVFC: The relative torque is the display value based on the rated unit current for the torque at the motor output shaft in 0.1% rated unit current. The absolute torque can be calculated from this value using the following formula:

$M_{abs} = M_{rel} \times I_N \times M_N / 1000 / I_{QN}$

M_{abs} = absolute torque

I_N = Rated unit current

M_{rel} = relative torque based on 0,1% I_N

M_N = Rated torque of the motor [Nm]

I_{QN} = Rated Q current [A] for selected connection type. The value is available in the operating modes CFC and SERVO / VFC1, VFC1 & hoist, VFC1 & DC braking and VFC1 & flying start.

GS_ACTSPEEDEXT: Actual speed of the external encoder (X14)

– H = Time base, average value filter for speed detection of external encoder.
  Setting range: 5 ms ... 31 ms
– H + 1 = Encoder type
  – 0 = Encoder X14,
  – 1 = DIP encoder
– H + 2 = Numerator for the user scaling value range: -2^{15} ... 0 ... $+(2^{15} - 1)$
– H +3 = Denominator for the user scaling value range: 1 ... $(2^{15} - 1)$
– H + 4 = DPointer, pointer to the result variable H", where H" = result; unit: [nX14] = (Inc/Time base)

Example: Enter the speed in arcs per hour. A structure `GS_ACTSPEEDEXT gLAActSpeed;` has been defined for this process.

```
gLAActSpeed.TimeBase = 30;      // Average value filter 30 ms
gLAActSpeed.EncType = 0;        // Encoder is connected to X14
gLAActSpeed.Numerator = 11250; // Conversion into arcs per hour 11250 / 384
gLAActSpeed.Denominator = 384;  // = (1000 ms x 60 s x 60 min) / (Inc. x Time
base)
gLAActSpeed.DPointer = numof(hArcsPerHour); // -11250 negated representation

_GetSys(gLAActSpeed,GS_ACTSPEEDEXT);
```

SPEEDMONITOR

Numerator value of the speed monitoring

The GETSYS command can be used as a prewarning for speed monitoring. Speed monitoring is triggered when the current is at the current limit for the number of seconds specified in P501. For example, if P501 = 200 ms, the GETSYS command can be used to query the numerator value. The travel speed is reduced after 50 ms. In this way, return travel can be made at rapid speed and, when under load, the speed can be reduced automatically by the inverter.

The following standard SEW structures are available for the _SetSys statement:

Instruction type	Standard structure	Elements	Brief description
_GetSys	GSAINPUT	Input1	Voltage value of analog input 1
		Input2	Voltage value of analog input 2
	GSAOUTPUT	Output1	Voltage value for optional analog output 1
		Output2	Voltage value for optional analog output 2
	GSCAM	SourceVar	Number of the variable on which the command is executed
		DbPreCtrl	Delay time feedforward in 0.1 ms
		DestVar	Number of the variable which is to receive the result
		BitPosition	Bit position in the result variable
		BitValue	Polarity in the result variable
		NumOfCam	Number of cam blocks (max. 4)
		PosL1	CCW limit value of cam block 1
		PosR1	CW limit value of cam block 1
		PosL2	CCW limit value of cam block 2
		PosR2	CW limit value of cam block 2
		PosL3	CCW limit value of cam block 3
		PosR3	CW limit value of cam block 3
		PosL4	CCW limit value of cam block 4
		PosR4	CW limit value of cam block 4
	GSCAM_EXT	CamControl	Bit 31 must always be set. 0x8000 0000 = function inactive, no new cam outputs will be generated, set outputs will be retained and deleted after a reset or voltage off/on only. 0x8000 0001 = function active internally, but all cam outputs will be turned off 0x8000 0002 = function active if drive is referenced (H473, Bit20 =1) 0x8000 0003 = function active even without referenced drive
		CamReserved1	Reserved
		CamOutShiftLeft	Shifts the internal data buffer of the outputs by n digits to the left before writing to the target variable CamDestination. Note: The shifting process will delete the information of the upper outputs. This means that if the shift factor is 3, the upper 3 outputs with 4 ms cycle time are no longer available, and the 4 outputs with 1 ms cycle time are assigned to bits 3-6 and the output with 4 ms cycle time is assigned to bit 7.
		CamForceOn	Mask to set mandatory outputs; the mask affects the internal data buffer prior to shifting with CamOutShiftLeft (NOT the target variable defined with CamDestination)
		CamForceOff	Mask to delete mandatory outputs; the mask affects the internal data buffer prior to shifting with CamOutShiftLeft (NOT the target variable defined with CamDestination) CamForceOff dominates CamForceOn

Instruction type	Standard structure	Elements	Brief description
		CamSource	Bit 31 switches between preset reference variables and an indicator to a random reference variable. Bit 31 = 0: • 0 = encoder X15 (motor encoder, H511) • 1 = encoder X14 (external encoder, H510) • 2 = encoder H509 (absolute encoder DIP11) • 3 = virtual encoder • all following values are reserved! Bit 31 = 1: CamSource includes a pointer to one IPOS$^{plus®}$ variable $+2^{31}$
		CamDestination	Pointer to target variable. The bits not used in the target variables are available for other functions (if you shift the outputs by four to the left with Shift Left, it frees up bits 0-3, bits 4-7 are available for the cam functions and bits 8-31 are available for any assignment. If the cam outputs are assigned to unit outputs (e.g. H481), you have to reserve these binary outputs with P620 - P639 as IPOS$^{plus®}$ outputs. The bits not used in this word are available for other outputs.
		CamOutputs	Number of outputs (max. 8)
		CamData 1	Pointer to first CamOutput structure (first output)
		...	
		CamData 8	Pointer to last CamOutput structure (eighth output)
	CAM_EXT_OUT	DeadTime	Delay time compensation for this channel (-500 ms..0..+500 ms) to compensate the delay time of an actuator connected to the inverter. The output is preset, depending on the rate of change of the reference variable value, in such a way that the output is switched in advance by this time interval.
		CamAreas	Number of the position windows for this channel (1 ... 4); the left limit value must always be smaller than the right one. If a modulo axis requires a position window that exceeds the 360° - 0° limit, then this range will have to be divided into two position windows. This process lets the operator set three related ranges for this output.
		LeftLimit1	CCW limit, window 1
		RightLimit1	CW limit, window 1
		...	...
		LeftLimit4	CCW limit, window 4
		RightLimit4	CW limit, window 4
	GSPODATA3	Bus types	0 = reserved 1 = S0 (RS485 #1) 2 = S1 (RS485 #2) 3 = Fieldbus 4 = reserved 5 = SBus 8 = SBus 2
		Len	Number of process output data items
		PO1	Process output data 1
		PO2	Process output data 2
		PO3	Process output data 3

Instruction type	Standard structure	Elements	Brief description
	GSACTSPEEDEXT	TimeBase	Cycle time for speed detection of external encoder, setting range: 5 ms ... 31 ms
		EncType	0 = encoder X14,1 = DIP encoder
		Numerator	Numerator for user scaling Value range: -2^{15} ... 0 ... $+(2^{15}-1)$
		Denominator	Denominator for user scaling Value range: 1 ... $+(2^{15}-1)$
		DPointer	Pointer to result variable H"
	GSPODATA10	Bus types	0 = reserved 1 = S0 (RS485 #1) 2 = S1 (RS485 #2) 3 = Fieldbus 4 = reserved 5 = SBus 8 = SBus 2
		Len	Number of process output data items
		PO1	Process output data 1
		PO2	Process output data 2
		PO3	Process output data 3
		PO4	Process output data 4
		PO5	Process output data 5
		PO6	Process output data 6
		PO7	Process output data 7
		PO8	Process output data 8
		PO9	Process output data 9
		PO10	Process output data 10

Unit-specific characteristics:

Element	Unit-specific characteristics	
	MOVIDRIVE® B	**MOVITRAC® B**
BusType (H+0)	GS_BT_S0 (RS485 at XT) GS_BT_S1 (RS485 at X13) GS_BT_FBUS=3 (fieldbus option) GS_BT_SBUS1 (SBus at X12) GS_BT_SBUS2 (via DFC11B)	only GS_BT_S1 (RS485 at FSC/FIO11B) GS_BT_SBUS1 (SBus at FSC/FIO21B)

Example

```
#include <const.h>

GSAINPUT Ain;

main()
{
 _GetSys( Ain,GS_ANINPUTS ); // Read analog inputs into structure Ain
}
```

17.3.9 _Go0

Syntax

```
_Go0( type )
```

Description

This command triggers reference travel of the axis. The argument defines the type of the reference travel. Reference travel is set with P903 and can only be changed there.

Key points

type Expression for setting the travel type during reference travel. type can adopt one of the following values:

GO0_C_W_ZP
GO0_U_W_ZP
GO0_C_NW_ZP
GO0_U_NW_ZP
GO0_C_W_CAM
GO0_U_W_CAM
GO0_C_NW_CAM
GO0_U_NW_CAM
GO0_RESET

The meaning of the individual letters is as follows:

C (Conditional) =	Reference travel only if reference travel has not yet been performed
U (Unconditional) =	Always referenced, regardless of whether the axis is already referenced or not
W (Wait) =	Waits in this statement line until reference travel performed
NW (NoWait) =	Process the next statement line during reference travel (recommendation)
ZP (Zero Pulse) =	Reference travel to zero pulse
CAM =	Reference travel to the reference cam
RESET =	Reference travel which has started is interrupted and the call is reset. An axis which has been referenced is now de-referenced.

INFORMATION

ZP and CAM have no effect if reference travel type P903 is set to 0, 5 or 8. If reference travel type P903 is set to type 3 or 4, CAM cannot be set.

Example

```
main()
{
 _Go0( GO0_C_W_ZP ); // reference waiting for zero pulse
}
```

17.3.10 _GoAbs

INFORMATION

If the modulo function is used for positioning, the commands GOA and GOR cannot be used. The target position is written directly to H454.

Syntax

```
_GoAbs ( type, pos )
```

Description

Absolute positioning to the position specified.

The message "IPOS in position" is updated within a GOA or GOR command; that is, the message can be queried directly in the next program line.

Key points

type Expression for the type of movement command. type can adopt one of the following values:

GO_NOWAIT: No wait, resumes processing of the program in the next statement line immediately after sending the movement command (recommendation)
GO_WAIT: Waits in this statement line until travel is completed

pos Contains the absolute target position; the following can stand for pos:

Constant expression for target position
Name of a variable containing the target position
Pointer to a variable containing the distance (indirect addressing).

Parameter settings for all positioning commands

Parameters	Explanation
P913/P914	Travel speeds (can be changed in the program using SETSYS).
P911/P912	Positioning ramps (acceleration) (can be changed in the program using SETSYS).
P915/P203	Precontrol that can be used to influence the jerk.
P933	Jerk limitation (only with MOVIDRIVE® B).
P916	Ramp type.
P917	Ramp mode.

Example

```
// Standard structures for speed and ramp
SSPOSSPEED tPosSpeed;
SSPOSRAMP tPosRamp;

main()
{
 // Set speed and ramp
 tPosSpeed.CW = tPosSpeed.CCW = 1000 * 10; // Speed 1000 rpm
 tPosRamp.Up = tPosRamp.Down = 1000;                  // Ramp is based on 3000
rpm
 _SetSys (SS_POSRAMP, tPosRamp);

 _SetSys (SS_POSSPEED, tPosSpeed);
 // If the speed and ramp are not changed in the program,
 // the values in SHELL apply / see the table

 _GoRel (GO_WAIT, 3000);                              // Moves to position 3000
Inc.
}
```

17.3.11 _GoRel

INFORMATION

If the modulo function is used for positioning, the commands GOA and GOR cannot be used. The target position is written directly to H454.

Syntax

```
_GoRel( type, pos )
```

Description

Relative positioning to a distance based on the current position.

The message "IPOS in position" is updated within a GOA or GOR command; that is, the message can be queried directly in the next program line.

Key points

type Expression for the type of movement command. type can adopt one of the following values:

GO_NOWAIT: No wait, resumes processing of the program in the next statement line immediately after sending the movement command (recommendation)
GO_WAIT: Waits in this statement line until travel is completed

pos Contains the relative distance; the following can stand for pos:

Constant expression for distance
Name of a variable containing the distance
Pointer to a variable containing the distance (indirect addressing),

Example

```
// Standard structures for speed and ramp
SSPOSSPEED tPosSpeed;
SSPOSRAMP tPosRamp;

main()
{
 // Set speed and ramp
 tPosSpeed.CW = tPosSpeed.CCW = 1000 * 10; // Speed 1000 rpm
 tPosRamp.Up = tPosRamp.Down = 1000;                  // Ramp is based on 3000
rpm
 _SetSys (SS_POSRAMP, tPosRamp);

 _SetSys (SS_POSSPEED, tPosSpeed);
 // If the speed and ramp are not changed in the program,
 // the values in SHELL apply / see the table

 _GoRel (GO_WAIT, 3000);                              // Moves to position 3000
Inc.
}
```

17.3.12 _InputCall

Syntax

```
_InputCall ( level, mask, function name )
```

Description

The function is used for calling up a user-defined function depending on the level present at the input terminals. The name of the function, the required polarity of the input level and the relevant terminals are specified as arguments. The event function is called up when all input terminals marked with a one in mask have a "1" level (level = IC_HIGH) or "0" level (level = IC_LOW).

Key points

level Constant expression which specifies the signal level for which terminals are to be tested. This expression can adopt one of the following values:

IC_HIGH: HIGH level ("1" level)
IC_LOW: LOW level ("0" level)

mask Constant binary expression which specifies the terminals to be tested.

The bits in the expression have the following meaning

Bit 0: DI00, mask = 0b1
Bit 1: DI01, mask = 0b10
Bit 2: DI02, mask = 0b100
Bit 3: DI03, mask = 0b1000
Bit 4: DI04, mask = 0b10000
Bit 5: DI05, mask = 0b100000
Bit 6: DI10, mask = 0b1000000
Bit 7: DI11, mask = 0b10000000
Bit 8: DI12, mask = 0b100000000
Bit 9: DI13, mask = 0b1000000000
Bit 10: DI14, mask = 0b10000000000
Bit 11: DI15, mask = 0b100000000000
Bit 12: DI16, mask = 0b1000000000000
Bit 13: DI17, mask = 0b10000000000000
Bit 14-31: Reserved

An input combination can be selected by setting the appropriate bits in the mask to 1. For example, to query DI00 and DI03, mask must be: 0b1001

function name Name of the event function. (Important: In contrast to a function call, only the name of the function without () is specified here)

Example

```
#include <constb.h>

#define DI02 0b100 // DI02 = 0b100

TerminalIsOne ()
{
 // Statements of the event function
}

main()
{
 while(1)
 {
  // Main program loop task 1
  _InputCall( IC_HIGH,DI02,TerminalIsOne );
  // if terminal DI02 == HIGH ("1"), call the function
 }
}
```

17.3.13 _Memorize

	INFORMATION If you use the command in a fast task, you have to set a _Wait command of at least 1 ms after the _Memorize command.

Syntax

```
_Memorize ( action )
```

Description

Enables IPOS$^{plus®}$ programs and/or variables to be saved or loaded in or from the non-volatile memory (EEPROM) on the unit. The action is specified via the argument.

Key points

action Constant expression for action. action can adopt one of the following values:

MEM_NOP: No data is saved
MEM_STALL: Saves program and variables
MEM_LDALL: Loads program and variables
MEM_STPRG: Saves program only
MEM_LDPRG: Loads program only
MEM_STDATA: Saves variables only
MEM_LDDATA: Loads variables only

	INFORMATION When using the _Memorize() command with MOVIDRIVE® A and MC07B, note that variables stored in the non-volatile memory (H0 – 127) and all parameters are not written cyclically. This is because the number of storage operations with the storage medium EEPROM is restricted to 10^5 storage operations. This restriction does not apply to MOVIDRIVE® B.

Example

```
main()
{
 _Memorize( MEM_STDATA ); // Save variables H0 ... H127 to EEPROM
}
```

17.3.14 _MoviLink

Syntax

```
_MoviLink ( H )
```

Description

The MOVLNK command allows extensive changes to be made to the inverter parameters and any other units which may be connected via the system bus or the RS-485. To ensure the safety of people and systems, take particular care when changing the inverter parameters. In all cases, higher-level safety precautions must be able to intervene to counteract any possible programming errors.

When the command is called, MOVLNK reads and writes process data, variables or parameters from one unit to another once, or reads or writes variables or parameters within a unit once.

The parameters are read/written using index addressing. For the corresponding index number, refer to the system manual and the parameter list. You can also display the index numbers in MOVITOOLS® MotionStudio by placing the mouse on the edit box or display field of the respective parameter (tooltip).

An SBus or RS-485 interface can be used for communication between 2 units.

MOVILINK can be used in a unit, for example, to save the variable of a quantity counter protected against power outage without using the MEM command to save the entire power-outage proof range. Process data cannot be exchanged within one unit using the MOVILINK command.

Using the index access via MOVILINK, user-defined inverter values that cannot be accessed with GETSYS/SETSYS can also be written/read from IPOS$^{plus®}$. In this way, for example, the inverter can set the parameters itself in the initialization section.

Before the command is called, initialize the variables that the command uses (command structure). The beginning of this command structure is transferred to the command as an argument. The data structure contains the data to be written or read.

Set the parameters for communication in the sender (master) and receiver (slave). The MOVILINK command is only called in the sender (master).

Key points

H Start variable of the command structure

The command structure is set up as follows:

H + 0: Bus type (communication interface)

H + 1: Address (target address)

H + 2: Format (process and/or parameter data)

H + 3: Service (read/write service)

H + 4: Index (number of the parameter to be modified or read, see parameter index directory)

H + 5: DPointer (Number of the variable H" from which the read data is stored or from where the data to be written is obtained. This means it is the first variable number of the data structure.)

- H" + 0: Contains the data for the parameter write services
- H" + 1: Contains the data that is read by a parameter service
- H" + 2: PO1 data of process data exchange
- H" + 3: PO2 data of process data exchange
- H" + 4: PO3 data of process data exchange
- H" + 5: PI1 data of process data exchange
- H" + 6: PI2 data of process data exchange
- H" + 7: PI3 data of process data exchange

H + 6: Result (Contains the error code after the parameter service has been executed, or contains zero if there was no error.)

The following standard SEW structures are available for the _MoviLink statement:

Instruction type	Standard structure	Elements	Brief description
_MoviLink	MOVLNK	BusType (H+0)	Possible bus types: ML_BT_S0 = 1 (RS485 #1) ML_BT_S1 = 2 (RS485 #2) ML_BT_SBUS1 = ML_BT_SBUS = 5 ML_BT_SBUS2 = 8
		Address (H+1)	0...99: Single address 100...199: Group address 253: Address of the inverter 254: Point-to-point connection 255: Broadcast If an SBus group address (e.g. 43) is addressed, the offset 100 must be added. In this case 143.

		Format (H+2)	Specification of the process (PD) and parameter (PARAM) channels for data transfer:
			//MoviLink Cyclic Frame Types
			ML_FT_PAR1 = 0: PARAM+1PD
			ML_FT_1 = 1: 1PD
			ML_FT_PAR2 = 2: PARAM+2PD
			ML_FT_2 = 3: 2PD
			ML_FT_PAR3 = 4: PARAM+3PD
			ML_FT_3 = 5: 3PD
			ML_FT_PAR = 6: Parameter (without PD)
			//Acyclic
			ML_CFT_PAR1 = 128
			ML_CFT_1 = 129
			ML_CFT_PAR2 = 130
			ML_CFT_2 = 131
			ML_CFT_PAR3 = 132
			ML_CFT_3 = 133
			ML_CFT_PAR = 134

		Service (H+3)	Communication service for parameters ML_S_RD = 1: Read service ML_S_WR = 2: Write to non-volatile memory ML_S_WRV = 3: Writing without saving
		Index (H+4)	Index number of the parameter to be modified or read (see parameter index directory) The subindex must be entered in the index element on bits 23-16 (least significant byte of the high word). Calculation: H+4 or `MOVILNK.Index = Index + (SubIndex << 16);`
		DPointer (H+5)	Number of the variable from which the read data is stored or from which the data to be written is obtained (structure MLDATA)
		Result (H+6)	Contains the error code after the service has been performed or contains zero if there was no error (see "Parameterization Return Codes" in the "Communication and Fieldbus Unit Profile" manual with "parameter list").

Instruction type	Standard structure	Elements	Brief description
	MLDATA	WritePar (H"+0)	Parameter that is sent for write services
		ReadPar (H"+1)	Parameter that is sent for read services
		PO1 (H"+2)	Process output data 1
		PO2 (H"+3)	Process output data 2
		PO3 (H"+4)	Process output data 3
		PI1 (H"+5)	Process input data 1
		PI2 (H"+6)	Process input data 2
		PI3 (H"+7)	Process input data 3

The following table shows the elements with unit-specific characteristics.

Element	Unit-specific characteristics		
	MOVIDRIVE® B	**MOVITRAC® B**	**MQx**
BusType (H+0)	only ML_BT_S1 (RS485 at X13) ML_BT_SBUS1 (SBUS at X12) ML_BT_SBUS2 (via DFC11B)	only ML_BT_S1 (RS485 at FSC/FIO11B) ML_BT_SBUS1 (SBUS at FSC/FIO21B)	only ML_BT_S1 (RS485 to MOVIMOT®)
Format (H+2)	no limitation	no limitation	only ML_CFT_2 (2PD acyclical) ML_CFT_PAR2 (Param + 2PD acyclical) ML_CFT_3 (3PD acyclical) ML_CFT_PAR3 (Param + 3PD acyclical) ML_CFT_PAR (Param acycl ical) cyclical frame types are possible but _MovCommDef is recommended.

INFORMATION

The element DPointer in the MOVLNK structure must be initialized with the first variable number of the data structure that contains the communication data.

If this data is contained in a structure with the name bus data (declaration line MLDATA bus data), the initialization line within the MOVLNK structure must read as follows for the DPointer element:

```
***.DPointer = numof(Bus data);
```

MOVLNK is a wait command. The next command is only processed when the MOVLNK command has been executed.

If two or more MOVLNK commands are called cyclically, these must be processed in **one** task. This process is mainly carried out for MOVIDRIVE® B in task 2 or task 3.

Example 1

```
#include <constb.h>

MOVLNK ml;
MLDATA mld;

main()
{
 while(1)
 {
  // Initialize structure ml
  ml.BusType  = ML_BT_S1; // RS-485 #2
  ml.Address  = 1;
  ml.Format   = ML_FT_PAR2; // 2 PD with parameter
  ml.Service  = ML_S_RD; // Read
  ml.Index    = 8300+(0<<16); // Index of the inverter status (8300.0)
  ml.DPointer = numof(mld); // Target structure

  _MoviLink( ml ); // actual command call
 }
}
```

Other examples

For further examples regarding the `_MoviLink` command, refer to the following sections:

- Reading an internal unit parameter (page 253)
- Writing a variable via SBus (page 254)
- Reading a parameter via SBus (page 255)

Parameter settings for the sender (master)

Addressing via RS-485: No settings required.

Addressing via SBus:

Parameters	Address	Explanation
P816		The baud rate depends on the length of the bus cable and must be the same for the sender and the receiver.

INFORMATION

With RS485 networks, there must only be **one** master.

In SBus (CAN) networks, there may be several active masters, see also `_SBusCommDef` command. (page 230)

Parameter settings for the receiver

Data exchange via parameter channel

Addressing via RS-485 (P810 ... P812)

Parameters	Address	Explanation
P810	0 ... 99	Individual addressing (sender address)
P811	101 ... 199	Group addressing (multicast), the sender can write to all receivers with the same group address at the same time
P812		Timeout monitoring function (deactivated if set to 0 ms or 650 ms)

Addressing via SBus P88_ and P89_

Parameters	Address	Explanation
P881/P891	0 ... 63	Single addressing
P882/P892	0 ... 63[1)]	Group addressing (multicast), the sender can write to all receivers with the same group address at the same time
P883/P893		Timeout monitoring function (deactivated if set to 0 ms or 650 ms)
P884/P894		The baud rate depends on the length of the bus cable and must be the same for the sender and the receiver.

1) When using the group address, increase the input value for the target address by 100.

Parameter *P880/P890 SBus protocol* must be set to "MoviLink".

SBus terminating resistors must be switched on or connected in the first and last stations.

Data exchange via process data channel

Serial communication must be set in accordance with the tables above (addressing via RS-485/SBus) for the process data exchange. The following additional settings are required to use the process data:

Parameters	Explanation
P100	Set setpoint source to "RS-485" or "SBus" (only if you want to use setpoint specification via process data communication)
P101	Set control source to "RS-485" or "SBus"
P870...876	Process data description (see detailed description in the "Communication and fieldbus unit profile" manual).

Parameter *P880/P890 SBus protocol* must be set to "MoviLink".

INFORMATION

It is important when using the MOVLNK command that the permanently saved variables (H0...127) and all parameters are not written cyclically with communication service = 2 (non-volatile) because the number of save processes for the used memory medium is limited.

	INFORMATION With MOVIDRIVE® B and MOVITRAC® B, the timeout monitoring is checked for telegrams received within the defined timeout interval. With MOVIMOT®, the timeout monitoring is activated with the first received cyclic frames (ML_FT... at the sender). Acyclical communication deactivates the timeout monitoring of MOVIMOT®. Once cyclical communication has been started with the _MovCommOn command, only the _MoviLink command to address 253 (internal) is possible. When using the _MoviLink command, other units can no longer be accessed.

17.3.15 _MovCommDef

The _MovCommDef command can only be used with MQx modules.

Syntax

```
_MovCommDef(H)
```

Description

The MovComm commands enable cyclical data exchange between MQx and usually up to 4 MOVIMOT® units via the RS-485 interface with the MOVILINK profile. _MovCommDef is used to set up a communication connection with MOVIMOT® by setting parameters such as the unit address, for example. _MovCommOn is used to start cyclical communication. Thereafter, the cyclical communication runs in the background, irrespective of the current command processing in the IPOS$^{plus®}$ program. A copy of the exchanged process data is available in the IPOS$^{plus®}$ variables and can be read and written there. Cyclical communication stops when the IPOS$^{plus®}$ program is stopped.

Up to 8 communication links are permitted. Note that the number of communication links has a very powerful influence on the bus cycle time of the RS-485 and therefore also on the response time of the MOVIMOT® unit. Approximately 20 ms bus cycle time must be taken into account per communication link or station. The prerequisite for achieving the 20 ms bus cycle time per station is fault-free cabling of the RS-485. If a timeout occurs during cyclical communication, this is displayed in fault 91 Gateway Sysfault. When a feedback signal is received from MOVIMOT®, the error message is revoked automatically.

Enter all information required to execute a command into a data structure in the variable area with a user program. The start of this variable structure is the argument for the command. The variable is defined by the **MOVCOM variable name;** and has the following structure.

BusType (H+0)	**Bus type (interface)** ML_BT_S1 = 2 (RS485 to MOVIMOT®)
Address (H+1)	**Individual address or group address for the MOVIMOT®to be addressed** 0 ... 99 single addressing 100 ... 199 group addressing 255 broadcast
Format (H+2)	**Entry of process data for data transfer** 3 = 2 process data words cyclically (for MOVIMOT®) = ML_FT_2 5 = 3 process data words cyclically (for MOVIMOT®) = ML_FT_3
Pd Pointer (H+3)	**Number of the variable H" in which the process data is stored or from which the data to be written is obtained**. (The data structure for H" is described in detail below.)
Para Pointer (H+4)	**Number of the variable H' in which the parameter data is stored or from which the data to be written is obtained**. MOVIMOT® does not support this function.

A variable structure containing the process data is defined in the Compiler by the **MCP-DATA variable name;**:

Data structure for H":	
H"+0	Contains the error code after connection, or zero if there was no error 0x05000002 indicates the connection has timed out.
H"+1	PO1 data of process data exchange
H"+2	PI1 data of process data exchange
H"+3	PO2 data of process data exchange
H"+4	PI2 data of process data exchange
H"+5	PO3 data of process data exchange
H"+6	PI3 data of process data exchange

The process data is coded according to MOVILINK.

A variable structure containing the parameter data is defined in the Compiler by the **MC-PARADATA variable name;**:

H*+0	Contains the error code after the parameter service has been performed, or contains zero if there was no error The errors are coded according to MOVILINK.
H*+1	0: No action or parameter data exchange is complete. 1: Start of the parameter data exchange
H*+2	ML_S_RD = 1: Read service ML_S_WR = 2: Write with storage in non-volatile memory ML_S_WRV = 3: Writing without saving
H*+3	Index number of parameter to be revised or read
H*+4	Read data after read service. Data to be written in case of a write service.

Proceed as follows when making parameter settings:

1. Entry of service, index and data
2. Start the parameter setting process by setting StartPar to 1.
3. Wait for the service to be performed; end is indicated when StartPar is set to 0.
4. Evaluate ParaResult. If an error has occurred, the data value is invalid. If no error occurred, the service was successful.

Argument

H First variable of the variable structure

Example

See the function _MovCommOn (page 229)

17.3.16 _MovCommOn

The _MovCommOn command can only be used with MQx modules.

Syntax

```
_MovCommOn()
```

Description

The command starts cyclical communication, communication links set up using MovCommDef are activated. As of this point, no MovCommDef command is permitted. Equally, no MOVILINK command to address ≠ 253 (internal) can be used.

Key points

None

Example

```
/*============================================
IPOS Source File
============================================*/
#include <const.h>
#include <io.h>

#pragma initials 0 127
#pragma globals 128 300
#pragma var 301 400

MOVCOM mc1;          // control values for communication link to MOVIMOT
MCPDATA mcpd1;         // process data exchange with MOVIMOT
MCPARADATA mcpara;    // parameter data exchange with MOVIMOT (not used)

/*============================================
Main Function (IPOS Entry Function)
============================================*/
main()
{
 // Initialization ============================
 // fill control structure for communication link to MOVIMOT
 mc1.BusType     = ML_BT_S1;     // communication via RS-485 to MOVIMOT
 mc1.Address     = 1;            // MOVIMOT address 1
 mc1.Format     = ML_FT_3;      // PDU type: 3 process data words cyclic
 mc1.PdPointer   = numof(mcpd1); // pointer to process data block
 mc1.ParaPointer = numof(mcpara1); // pointer to parameter data block
 _MovCommDef( mc1 );
 _MovCommOn(  );

 while( )
 {

 }
}
```

17.3.17 _Nop

Syntax

```
_Nop()
```

Description

No operation is performed. This command can be used, for example, to achieve wait times on the basis of the command cycle time.

Argument

The command does not have an argument.

Example

```
main()
{
 _Nop(  );
}
```

17.3.18 _SBusCommDef

Syntax

```
_SBusCommDef( object type, H)
```

Description

This statement sets up a data object for cyclical or acyclical data transfer. This object can be used to transfer up to 2 variables (8 bytes) via the system bus. The data object is written to a variable structure, the initial variable of which is specified in h. The cyclical data transmission must be started via function SBusCommOn () or SBusCommState (action) (see the following pages). The type of the data object is specified in objecttype.

Key points

objecttype Expression that can adopt one of the following values:

SCD_REC: Receive
SCD_TRCYCL: Cyclical send
SCD_TRACYCL: Acyclical send

H First variable in the variable structure

Corresponding data structures have been defined for the individual object types.

SCD_REC

Initializes a data object that receives the data. A maximum of 32 variables can be set up.

The object has the following structure:

H+0: Object number

H+1: Number of data bytes and data format

H+2: Number of the variable H" from which point the received data is stored

SCD_TRCYCL

Initializes a data object, whose data is transmitted cyclically. .

The object has the following structure:

H+0: Object number

H+1: Cycle time ms

H+2: Offset time ms

H+3: Number of data bytes and data format

H+4: Number of the variable H" where the data to be transmitted starts

H+5: Result of the SCOM command

SCD_TRACYCL Initializes a data object, whose data is transmitted immediately once.

The object has the following structure:

H+0: Object number

H+1: Number of data bytes and data format

H+2: Number of the variable H" where the data to be sent begins

H+3: Status of the transmission command

INFORMATION

Prior to transmitting acyclical telegrams, the SBus must also be activated with _SBusCommOn or _SBusCommState.

MOVIDRIVE® B: The IPOS$^{plus®}$ program waits at this command until the message has been sent, but for a maximum of 10 ms. Users can only monitor whether the telegram has been sent correctly by evaluating the state (H+3) or the expected response.

The following standard SEW structures are available for the _SBusCommDef statement:

Instruction type	Standard structure	Elements	Brief description
_SBusCommDef	SCREC	ObjectNo (H+0)	Object number CAN Identifier (e.g. 1024)
		Format (H+1)	Data format
		DPointer (H+2)	Number of the variable H" from which point the received data is stored There must be 2 variables (H" and H"+1) reserved for the reception of up to 8 bytes of data.
	SCTRCYCL	ObjectNo (H+0)	Object number (e.g. without CANopen profile as of 1024
		CycleTime (H+1)	Cycle time [ms]
		Offset (H+2)	Offset time [ms]
		Format (H+3)	Number of data bytes and data format
		DPointer (H+4)	Number of the variable H" where the data to be sent begins
		Result (H+5)	Status of the transmission command: ≥0 Free bus capacity in % (calculated value of this unit) -1 Incorrect cycle time -2 Too many objects set up -3 Bus overload -5 Wrong object number -6 Wrong length
	SCTRACYCL	ObjectNo (H+0)	Object number (e.g. without CANopen profile as of 1024
		Format (H+1)	Number of data bytes and data format
		DPointer (H+2)	Number of the variable H" where the data to be sent begins
		Result (H+3)	Status of the transmission command: 0 = Ready 1 = Transmitting 2 = Transmission successful 10 = Transmission error

If objects defined via SCREC are received via SBus1 or SBus2, this is signaled in the corresponding system variables H522 and H523, see System variable overview (page 29).

Bit 24 of the ObjectNo defines whether the data are transmitted or received with the CAN identifier (bit 0 ... 10) via SBus1 or SBus2:

Bit 24 = 0: SBus1 (.ObjectNo = CAN_ID + SCD_SBUS1)

Bit 24 = 1: SBus2 (.ObjectNo = CAN_ID + SCD_SBUS2); only MDX B with DFC11B

Unit-specific characteristics:

Element	Unit-specific characteristics	
	MOVIDRIVE® B	**MOVITRAC® B**
CycleTime (H+1)	Valid cycle times[1]: - 1, 2 ... 9 ms, number of objects 15 - 10, 20, ... 65530 ms	Valid cycle times: 1 ... 255 ms, granularity 1 ms, number of objects 16
Offset (H+2)	Valid offset times: - 0, 1, 2 ... 8 ms for cycle times < 10 ms - 0, 10, 20, ... 65530 ms for cycle times ≥ 10 ms	Valid offset times: 0 ... 255 ms, granularity 1 ms The following must apply: Offset time + cycle time ≤ 255

1) The cycle time must always exceed the longest offset time.

Number of data bytes and data formats:

Bit	Value	Function
0 ... 3	0 ... 8	Number of data bytes
4 ... 7	--	Reserved
8	0	MOTOROLA format
	1	INTEL format
9 ... 31	--	Reserved

Comparison of MOTOROLA and INTEL format:

	MOTOROLA format		**INTEL format**	
CAN byte	3 2 1 0	3 2 1 0	0 1 2 3	0 1 2 3
Variable	H"+1	H"	H"	H"+1
Var. byte	3 2 1 0	3 2 1 0	0 1 2 3	0 1 2 3

INFORMATION

Observe the following rules when selecting the object number CAN Identifier:

1. In the entire SBus network, an object number can only be set up for transmission once.
2. Within a unit, an object number may only be set up once; either to be sent or received once.

In particular during further data exchange between the slaves, you must ensure that the total calculated bus utilization does not exceed 70%.

The bus utilization is calculated in bits per second using the formula:

Number of telegrams × bits/telegram × 1/cycle time

For example, 2 messages with 100 bits in 1 ms cycle = 200000 bits/s = 200 kBaud

This results in the following bus load percentage in reference to the selected baud rate.

For example, 200 kBaud / 500 kBaud = 40% < 70%

For points 1 and 2, note that the unit firmware reserves its own object numbers automatically:

- The object number entered in parameters P885/P895 for SBus synchronization.
- The following object numbers are used for communication via the MOVILINK profile depending on the SBus address in parameter P881/P891 and the SBus group address in parameter P882/P892:
  - 8 × SBus address + 3 — for process output data
  - 8 × SBus address + 4 — for process input data
  - 8 × SBus address + 5 — for synchronous process output data
  - 8 × SBus address + 3 + 512 — for parameter request service
  - 8 × SBus address + 4 + 512 — for parameter response service
  - 8 × SBus group address + 6 — for group process data
  - 8 × SBus group address + 6 + 512 — for group parameter request

For communication via the CANopen profile, the object numbers (identifiers) defined in DS301 by CANopen will be used.

Example See _SBusCommStat

17.3.19 _SBusCommOn

Syntax `_SBusCommOn()`

Description In MOVIDRIVE® B, the command has been replaced by _SBusCommState. However, due to downward compatibility, it can still be used.

This statement triggers the reception of data and the cyclical transmission of previously defined data objects. The data objects are initialized using the SBusCommDef function with the arguments SCD_TRCYCL and SCD_REC.

	INFORMATION This command only activates SBus 1, not SBus 2

Argument The command does not have an argument.

Example See section "Compiler – Examples".

17.3.20 _SBusCommState

Syntax `_SBusCommState ( action )`

Description This statement initializes the CAN interface, starts or stops the data reception and the acyclic transmission of predefined data objects via SBus 1 or SBus 2. The data objects re initialized via the SBussCommDef function.

Regardless of the value for "action", with MOVITRAC® B, the _SBusCommState command (action) always has the same effect as _SBusCommOn (page 234).

Key points action can adopt one of the following values:

Value	Argument	Meaning
0	SCS_STARTALL	Starts cyclical communication synchronously from SBus 1 and SBus 2.
1	SCS_STOPALL	Stop cyclical communication synchronously from SBus 1 and SBus 2.
2	SCS_START1	Starts cyclical communication from SBus 1.
3	SCS_STOP1	Stops cyclical communication from SBus 1.
4	SCS_START2	Starts cyclical communication from SBus 2.
5	SCS_STOP2	Stops cyclical communication from SBus 2.

Example

```
#include <constb.h>

#define  DATA     H20
#declare DATE DATA:0

#define  INTEL     0x100
#define  NUM_BYTES 4

SCTRCYCL Obj1;

main()
{
 Obj1.ObjectNo  = 1090;
 Obj1.CycleTime = 10;
 Obj1.Offset    = 0;
 Obj1.Format    = INTEL | ANZ_BYTES // Set high und low byte
 Obj1.DPointer  = numof(DATA);
 DATUM = 0;

 _SBusCommDef( SCD_TRCYCL,Obj1 ); // Send obj1 cyclically
 _SBusCommState( SCS_START1 ); // Start of the transmission for SBus1

 while(1)
 {
  // Main program task 1
 }
}
```

17.3.21 _SetInterrupt

Syntax

```
_SetInterrupt( event , function name)
```

Description

The function is used for specifying a user-defined function as an interrupt routine. The name of the function is given as an argument. An interrupt may be triggered by various events. The required event is given as an argument.

Key points

event Constant expression that can adopt one of the following values:

SI_DISABLE:	Interrupt is inhibited
SI_ERROR:	Triggers an interrupt in case of a system error
SI_TIMER0:	Triggers an interrupt when Timer0 is exceeded
SI_TOUCHP1:	Initiates an interrupt in case of an edge change on a touch probe terminal if touch probe was activated

function name Name of the interrupt function. (Important: In contrast to a function call, only the name of the function without () is specified here.)

Example

```
#include <constb.h>

T0Interrupt ()
{
 // Statements of the interrupt routine for timer 0
}

main()
{
 // Inform system of TO interrupt and start
 _SetInterrupt( SI_TIMER0,T0Interrupt );
 while(1)
 {
  // Main program task 1
 }
}
```

17.3.22 _SetSys

Syntax

```
_SetSys( sys , H)
```

Description

Sets the value of an internal system value with the value of an IPOS$^{plus®}$ variable.

Key points

H Name of source variable

sys Constant expression that designates the system value. sys can adopt one of the following values:

SS_N11: Internal fixed setpoint n11
SS_N12: Internal fixed setpoint n12
SS_N13: Internal fixed setpoint n13
SS_N21: Internal fixed setpoint n21
SS_N22: Internal fixed setpoint n22
SS_N23: Internal fixed setpoint n23

Note:

The new fixed setpoint is only certain to have been adopted after 5 ms. You may want to delay program processing after a _SetSys command by 5 ms with a _Wait command.

If the fixed setpoint value exceeds the permitted range, the algebraic sign changes.

SS_PIDATA: Updates PI data[1)]

- H = Number of PI data items
- H + 1 = PI data 1
- H + 2 = PI data 2
- H + 3 = PI data 3

SS_OPMODE: Sets the operating mode

- H = 11: CFC (speed control)
- H = 12: CFC & torque control
- H = 13: CFC & IPOS (positioning)
- H = 14: CFC & synchronous operation (DRS11)
- H = 16: SERVO (speed control)
- H = 17: SERVO & torque control
- H = 18: SERVO & IPOS (positioning)
- H = 19: SERVO & synchronous operation (DRS11)

SS_IMAX: Setting the torque limit by setting parameter P304 torque limit (only CFC or SERVO); Scale unit: 0.1%

SS_POSRAMP: Positioning ramps; unit: 1 ms

- H = Positioning ramp 1
- H + 1 = Positioning ramp 2

SS_POSSPEED: Positioning speed; unit: 0.1 rpm

- H = Speed CW
- H + 1 = Speed CCW

SS_OVERRIDE: Switch override on/off

- H = 0 -> off
- H = 1 -> on

SS_BRAKE: Switching the brake function on/off
– H = 0 -> off
– H = 1 -> on

SS_RAMPTYPE: Specify positioning ramp type (changes P916)
– H = 0 -> linear
– H = 1 -> sine
– H = 2 -> square
– H = 3 -> bus ramp
– H = 4 -> jerk limited
– H = 5 -> cam disk
– H = 6 -> internal synchronous operation

SS_RESET: Resets the system error with the error number in variable H
– H = Variable with the error number

SS_ACTPOS: Setting the actual position
– H = Position value

SS_SPLINE:

Internal drive calculation of an analytical cam disk. Currently, the function is only available in MCH in SD version 0C or MDxB SD -0C/5C.

The spline calculation is initialized via the system function after up to 20 curve points (x-y = value pairs, x = master position, y = slave position) have been specified in a master encoder range. The calculation is then started using `H+0 SplineMode` and either a complete cam disk or one segment of a selected cam disk is filled. Currently, a spline 0 procedure (for optimum running) and a spline 1 procedure (for section-by-section movements and straight sections) are available. The calculation is complete after ≤ 200 ms.

– H+0 = SplineMode: (Value range: 0 ... 3)
  - = 0: Interpolation not active, or calculation is finished
  - = 1: Start interpolation, enter interpolated values from index 0 starting with the electronic cam (in ascending order, from index 0 to 512).
  - = 2: Start interpolation, enter interpolated values from index 512 starting with the electronic cam (in descending order, from index 512 to 0).
  - = 3: Preparatory parameter calculation for interpolation concluded; start entering interpolated values in the electronic cam.
– H+1 = SplineModeControl: Reserved
– H+2 = SplineDest: (Value range: 0 ... 5)
  Number of the electronic cam in which the interpolated values are to be entered.
– H+3 = SplineNUser: (Value range: 2 ... 20)
  Number of curve points to be used for interpolation and the calculation process (bit 0 ... bit 4 = number of curve points, bit 7 = 0: spline 0, bit 7 = 1: spline 1)
– H+4 = SplineX0User: (Only a value >= 0 can be entered here!)
  Enter the curve point no. of the X axis (master).
– H+5 = SplineY0User: (Value range: long = -2^{31} ... 0 ... (2^{31} -1))
  Y value (= position value) of the 1st curve point; when ACTPOSSCALE ≠ 0, the scaled value must be entered in the structure
– ...
– H+42 = SplineX19User: (Only a value <= 512 can be entered here!)
  Enter the curve point no. of the X axis (master).
– H+43 = SplineY19User: (Value range: long = -2^{31} ... 0 ... (2^{31} -1))
  Y value of the 20th curve point; when ACTPOSSCALE ≠ 0, the scaled value must be entered in the structure

SS_MULTIAXIS: Total drive calculation of a trajectory

Only available on request. See also the addendum to the operating instructions "Special design SK-0C for MCH or MDxB: Calculated Curves with MCH".

1) Applies if parameter P101 is set to "RS485", "Fieldbus" or "SBus".

The following standard SEW structures are available for the _SetSys statement:

Instruction type	Standard structure	Elements	Brief description
_SetSys	SSPOSRAMP	Up	Acceleration positioning ramp (ms)
		Down	Deceleration positioning ramp (ms)
	SSPOSSPEED	CW	Positioning speed CW (0.1 rpm)
		CCW	Positioning speed CCW (0.1 rpm)
	SSPIDATA3[1)]	Len	Number of the process input data to be transmitted
		PI1	Process input data 1
		PI2	Process input data 2
		PI3	Process input data 3
	SSPIDATA10[1)]	Len	Number of the process input data to be transmitted
		PI1	Process input data 1
		PI2	Process input data 2
		PI3	Process input data 3
		PI4	Process input data 4
		PI5	Process input data 5
		PI6	Process input data 6
		PI7	Process input data 7
		PI8	Process input data 8
		PI9	Process input data 9
		PI10	Process input data 10

1) Applies if parameter P101 is set to "RS485", "Fieldbus" or "SBus".

Example

```
main()
{
 // Set the speed control operating mode
 H0 = 11;
 _SetSys( SS_OPMODE,H0 );
}
```

17.3.23 _SetTask

Syntax

```
_SetTask ( control word, function name )
```

Description

This function is used to determine a user-defined function as a task and to start or stop this task. The name of the function and the control word are given as arguments.

Argument

control word Constant expression that can adopt one of the following values:

MOVIDRIVE® B	**MOVIDRIVE® A**
ST2_STOP: Stop task 2	T2_START: Start task 2
ST2_START: Start task 2	T2_STOP: Stop task 2
ST3_STOP: Stop task 3	
ST3_START: Start task 3	

function name Name of the task function.

Example

```
#include <constb.h>

MyTask3 ()
{
 // Statements of task 3
}

main()
{
 // Inform system of task 3 and start
 _SetTask ( ST3_START,MyTask3 );
 while(1)
 {
  // Main program
 }
}
```

17.3.24 _SetTask2

Syntax

```
_SetTask2( control word, function name )
```

Description

This function is used to determine a user-defined function as task 2 and to start or stop this task. The name of the function and the control word are given as arguments. The control word and start address are both set to 0 when the power is switched on, i.e. Task2 is deactivated.

In MOVIDRIVE® B, the command has been replaced by _SetTask. However, due to downward compatibility, it is still available with MOVIDRIVE® B.

Key points

control word Constant expression that can adopt one of the following values:

T2_STOP: Stop task 2
T2_START: Start task 2

function name Name of the Task2 function. (Important: In contrast to a function call, only the name of the function without () is specified here.)

Example

```
#include <constb.h>

MeineTask2 ()
{
 // Statements of task 2
}

main()
{
 // Inform system of task 2 and start
 _SetTask2( T2_START,MyTask2 );
 while(1)
 {
  // Main program
 }
}
```

17.3.25 _SetVarInterrupt

Syntax

```
_SetVarInterrupt ( h1 , function name )
```

Description

This command is not available in MOVIDRIVE® A, only as of MOVIDRIVE® B.

The command activates a variable interrupt with the data structure as of variable H1. If the condition for the interrupt is fulfilled, the "function name" function is performed. The event for the interrupt is the comparison with a variable value (see H+4). If the data structure has been initialized, during run time the behavior of the interrupt can be dynamically adapted to a complete VarInterrupt using an IPOS$^{plus®}$ command.

Note: The data from the data structure is only transferred when the command `_SetVarInterrupt ( H1 , function name )` is called (data consistency). An exception is the variable `pSourceVar`.

Example: If the value from the data structure Hx+3 CompareVar is changed, for example, the value is only taken into account with the command `_SetVarInterrupt ( H1 , function name )`.

Key points

H1 First variable of a data structure (see table H+0)

function name Name of the interrupt function. In contrast to a function call, only the name of the function without () is specified here.

Data structure of the variable interrupt:

Variable	VARINT element structure	Description
H+0	Control	0: All VarInterrupt = OFF/Reset 1: Interrupt task 2 2: Interrupt task 3
H+1	IntNum	0 ... 3: Defines a sequential number of the VarInterrupt. An interrupt with the number x, which has already been activated, can be reactivated during the program run time with another data structure using the command call `_SetVarInterrupt ( H1 , function name )` when the same interrupt number is specified in the new data structure at the position H+1. This feature is not available for the task 1 interrupts.
H+2	SrcVar	Number of the reference variable whose value is compared with the comparison value.
H+3	CompVar	Comparison value or mask used to compare the value of the H+2 reference variable.

Variable	VARINT element structure	Description
H+4	Mode	0: No interrupt event. This can be used to deactivate this one interrupt without deactivating them all. 1: One of the bits of the reference variable, masked out using the CompVar mask, has changed its status: ([*SrcVar(t) ^ *SrcVar(t-T)] & CompVar) != 0 2:As long as the value of the reference variable is equal to the comparison value (*SrcVar == CompVar) 3:As long as the value of the reference variable is not equal to the comparison value (*SrcVar != CompVar) 4:As long as the value of the reference variable is greater than or equal to the comparison value (*SrcVar >= CompVar) 5:As long as the value of the reference variable is less than or equal to the comparison value (*SrcVar <= CompVar) 6: Value of the reference variable AND the comparison value is not 0 ((*SrcVar & CompVar) != 0) 7: Value of the reference variable AND the comparison value is 0 ((*SrcVar & CompVar) == 0) 8: Positive edge of the bit masked out by CompVar 9: Negative edge of the bit masked out by CompVar 10: As 2; however, interrupt is only processed once each time the condition is fulfilled (edge triggered) 11: As 3; however, interrupt is only processed once each time the condition is fulfilled (edge triggered) 12: As 4; however, interrupt is only processed once each time the condition is fulfilled (edge triggered) 13: As 5; however, interrupt is only processed once each time the condition is fulfilled (edge triggered)
H+5	Priority	Priority of the interrupt (1 ... 10); task 2 and task 3 are both assigned the priority 0.
H+6	IntEvent	Process image of the reference variable from *SourceVar to the time of the interrupt.

Example See "Task Management and Interrupts / Variable Interrupts with MOVIDRIVE® B".

17.3.26 _SystemCall

Syntax

```
_SystemCall( event, function name)
```

Description The function is used to call a user-defined function when a system-controlled even occurs. The name of the function and the required event are given as arguments.

Key points

event Constant expression that specifies when the function name is called. This expression can adopt one of the following values:

SC_UC: Unconditional
SC_N0: When the speed is zero
SC_N: When the speed is not zero
SC_NOTPOS: If not in position
SC_TP1: If there is an edge change at touch probe terminal DI02
SC_NTP1: If there is no edge change at touch probe terminal DI02
SC_TP2: If there is an edge change at touch probe terminal DI03
SC_NTP2: If there is no edge change at touch probe terminal DI03

function name Name of the event function. (Important: In contrast to a function call, only the name of the function without () is specified here.)

Example

```
#include <constb.h>

SpeedZero () // Event function
{
 // Statements of the event function
}

main()
{
 while(1)
 {
  // Main program task 1
  _SystemCall( SC_N0,SpeedZero );
     // if speed == zero, call function
 }
}
```

17.3.27 _TouchProbe

Syntax

```
_TouchProbe( action )
```

Description

Enables or locks a touch probe input. Touch probe inputs are the input terminals DI02 and DI03.

It takes 100 µs to store the touch probe positions, regardless of ongoing program processing. The terminal level must have been altered for at least 200 µs to be detected reliably. The argument can be used to select the edge change that causes a touch probe.

If an edge change occurs on the enabled input, the current actual positions are saved in specified IPOS$^{plus®}$ system variables. To take another measurement, the touch probe must be enabled again.

The touch probe positions are stored in the following variables:

Encoder	Encoder position	Position of touch probe 1 (DI02)	Position of touch probe 2 (DI03)
Motor encoder X15	H511 ActPos_Mot	H507 TpPos1_Mot	H505 TpPos2_Mot
External encoder X14	H510 ActPos_Ext	H506 TpPos1_Ext	H504 TpPos2_Ext
Absolute encoder X62	H509 ActPos_Abs	H503 TpPos1_Abs	H502 TpPos2_Abs
Virtual encoder (only for MOVIDRIVE® B)	H376	H501 TpPos1_VE	H500 TpPos2_VE

Key points

action can adopt one of the following values:

TP_EN1: Enables the touch probe input DI02
TP_DIS1: Inhibits the touch probe input DI02
TP_EN2: Enables the touch probe input DI03
TP_DIS2: Inhibits the touch probe input DI03
TP_EN1_HI: Enables the touch probe input DI02 with rising edge
TP_EN1_LO: Enables the touch probe input DI02 with falling edge
TP_EN2_HI: Enables the touch probe input DI03 with rising edge
TP_EN2_LO: Enables the touch probe input DI03 with falling edge

Example

```
main()
{
 _TouchProbe( TP_EN1 ); // Enables the touch probe input DI02
}
```

17.3.28 _Wait

Syntax

```
_Wait( time )
```

Description

Waits for the period (in milliseconds (ms)) specified in a constant.

Key points

time Constant that specifies the wait time in milliseconds; no variable possible.

	INFORMATION If the waiting time is to be variable, you will have to initialize a timer (H487 ...H489) instead of a WAIT command and program a loop until the timer has expired.

Example

```
   Timer_0 = 20000;    // start value 20 s
while( Timer_0 ){}  // wait 20 s
```

17.3.29 _WaitInput

Syntax

```
_WaitInput ( level, mask )
```

Description

The function waits until a specific level is present at specific input terminals. The required polarity of the input level and the relevant terminals are given as arguments. The function waits until all input terminals marked with a one in mask have a "1" level or a "0" level.

Key points

level Constant expression that specifies which signal level the terminals should be tested for. It can adopt one of the following values:

1: HIGH level ("1" level)
0: LOW level ("0" level)

mask Constant binary expression which specifies the terminals to be tested. The bits in the expression have the following meaning

Bit 0: DI00, mask = 0b1
Bit 1: DI01, mask = 0b10
Bit 2: DI02, mask = 0b100
Bit 3: DI03, mask = 0b1000
Bit 4: DI04, mask = 0b10000
Bit 5: DI05, mask = 0b100000
Bit 6: DI10, mask = 0b1000000
Bit 7: DI11, mask = 0b10000000
Bit 8: DI12, mask = 0b100000000
Bit 9: DI13, mask = 0b1000000000
Bit 10: DI14, mask = 0b10000000000
Bit 11: DI15, mask = 0b100000000000
Bit 12: DI16, mask = 0b1000000000000
Bit 13: DI17, mask = 0b10000000000000
Bit 14-31: Reserved

An input combination can be selected by setting the appropriate bits in the mask to 1. For example, to query DI00 and DI03, mask must be: 0b1001

Example

```
#include <constb.h>

main()
{
 _WaitInput( 1,0b100 );
 // as long as terminal DI02 == HIGH ("1"), wait
}
```

17.3.30 _WaitSystem

Syntax

```
_WaitSystem( event )
```

Description

The function waits for as long as a system-related event is present. The required event is given as an argument.

Key points

event Constant expression that specifies when the function waits. This expression can adopt one of the following values:

SC_UC: Unconditional
SC_N0: When the speed is zero
SC_N: When the speed is not zero
SC_NOTPOS: If not in position
SC_TP1: If there is an edge change at touch probe terminal DI02
SC_NTP1: If there is no edge change at touch probe terminal DI02
SC_TP2: If there is an edge change at touch probe terminal DI03
SC_NTP2: If there is no edge change at touch probe terminal DI03

Example

```
main()
{
 _WaitSystem( SC_N0 ); // as long as speed == zero, wait
}
```

17.3.31 _WdOff

Syntax

```
_WdOff()
```

Description

The watchdog is switched off.

Argument

The command does not have an argument.

Example

```
main()
{
 WdOFF();
}
```

17.3.32 _WdOn

Syntax

```
_WdOn( time )
```

Description

Sets the value of the watchdog counter to the value specified in 'time.' If the watchdog timer elapses, task 1 and task 2 are stopped and an error message is issued. The application has to prevent the watchdog timer from running down by cyclically resetting the counter. The counter value has to last at least as long as one main program cycle.

Key points

time Watchdog counter value in milliseconds (ms).

Example

```
#define WD_TIME 1000

main()
{
 while(1)
 {
  /*
  Perform statements in the loop
  The total run time of the statements in the loop
  must not be longer than 1000 ms to prevent
  the watchdog from running down.
  */

  _WdOn( WD_ZEIT ); // Retrigger WD every 1000 ms
 }
}
```

18 Compiler – Examples

18.1 Setting bits and output terminals

There are two ways of setting individual bits in variables:

1. The _BitSet (Hx, y) function sets bit y in variable x to one.
2. The bit-by-bit OR operation Hx ¦ K sets those bits in variable x to one which are also set to one in constant K.

In both cases, the legibility of the program can be improved if the bit position or the constant is defined symbolically. Bit setting functions are mainly used for setting binary unit outputs. Therefore, in the following example, variable H481 (StdOutpIPOS) will be used as the target variable of the operation. Variable H480 (OptOutpIPOS) would be used accordingly to address the outputs of the option. In the example, the output terminal DO02 of the basic unit is to be set.

Using _BitSet()	Using the OR operation

`#include <const.h>`
`#include <io.h>  // MOVIDRIVE A`
`#include <iob.h> // MOVIDRIVE B`
`main()`
`{`
`  _BitSet( StdOutpIPOS, 2 );`
`}`
	`#include <const.h>`
	`#include <io.h>  // MOVIDRIVE A`
	`#include <iob.h> // MOVIDRIVE B`
	`main()`
	`{`
	`  StdOutpIPOS ¦= DO02;`
	`}`

The source text can be simplified even further if symbolic designators are used for the corresponding statements as well as the variables and constants:

Using _BitSet():

```
#include <const.h>
#include <io.h>    // MOVIDRIVE A
#include <iob.h> // MOVIDRIVE B
#define SetDO02           _BitSet( StdOutpIPOS, 2);
main()
{
   Set DO02
}
```

If several outputs are to be set at the same time, then you can either call the _BitSet() function several times in succession or use the bit-by-bit OR logic operation for this. In the second case, one statement will suffice. This reduces the amount of code and thus also has a positive effect on the program run time.

The following example uses the OR operation to set DO01 and DO02 at the same time.

Using the OR operation:

```
#include <const.h>
#include <io.h>    // MOVIDRIVE A
#include <iob.h> // MOVIDRIVE B
main()
{
   StdOutpIPOS ¦= DO01 ¦ DO02;
}
```

18.2 Clearing bits and output terminals

There are two ways to clear individual bits in variables:

1. The _BitClear (Hx, y) function clears bit y in variable x.
2. The bit-by-bit AND operation Hx & K sets those bits in variable x to one that are also set to one in constant K.

In both cases, the legibility of the program can be improved if the bit position or the constant is defined symbolically. Bit clearing functions are mainly used to reset binary unit outputs. Therefore, in the following example, variable H481 (StdOutpIPOS) will be used as the target variable of the operation. Variable H480 (OptOutpIPOS) would be used accordingly to address the outputs of the option. In the example, the output terminal DO02 of the basic unit is to be set to zero.

Using _BitClear()	Using the AND operation

`#include <const.h>`
`#include <io.h>  // MOVIDRIVE A`
`#include <iob.h> // MOVIDRIVE B`
`main()`
`{`
`  _BitClear( StdOutpIPOS, 2 );`
`}`
	`#include <const.h>`
	`#include <io.h>  // MOVIDRIVE A`
	`#include <iob.h> // MOVIDRIVE B`
	`main()`
	`{`
	`  StdOutpIPOS &= ~DO02;`
	`  /*The operator "~" causes bit-by-bit`
	`negation of DO02. Thus all the bits`
	`of DO02 are 1 except for bit 2  */`
	`}`

If several outputs are to be reset at the same time, then you can either call the _BitClear() function several times in succession or use the bit-by-bit AND logic operation. In the second case, one statement will suffice. This reduces the amount of code and thus also has a positive effect on the program run time.

The following example uses the AND operation to clear DO01 and DO02 at the same time.

Using the AND operation:

```
#include <const.h>
#include <io.h>    // MOVIDRIVE A
#include <iob.h> // MOVIDRIVE B
main()
{
 StdOutpIPOS &= ~DO01 & ~DO02;
}
```

18.3 Querying bits and input terminals

To query what level a certain input terminal has, a bit must be tested with a variable. The variable is either H483 (InputLevel), which contains the levels of the binary inputs, or a variable h of your choice which contains the levels after the _GetSys() function has been performed.

18.3.1 Testing single bits

To test a bit in a variable, perform an AND operation using a constant in which the bit to be tested is set to one.

If the result is zero, then the bit to be tested is also zero and thus the input terminal level is low. If the result is not zero, then the bit is one.

The following example sets H10 to 1 if binary input DI03 is set to one.

Testing individual bit using H483

```
#include <const.h>
#include <io.h>    // MOVIDRIVE A
#include <iob.h> // MOVIDRIVE B
main()
{
   if(( InputLevel & DI03 ) != 0)
 {
  H10 = 1;
 }
}
```

Testing individual bit using _GetSys()

```
#include <const.h>
#define INPUTS H1
#include <io.h>    // MOVIDRIVE A
#include <iob.h> // MOVIDRIVE B
main()
{
   _GetSys( INPUTS, GS_INPUTS );
   if(( INPUTS & DI03 ) != 0)
 {
  H10 = 1;
 }
}
```

18.3.2 Testing several bits

In order to test several bits of a variable for a certain state, you have use an AND operation to mask the bits to be tested and compare the result with a constant that corresponds to the bit pattern to be tested.

The following example sets H10 to 1 if there is a 1 at DI01 and a 0 at DI03.

```
#include <const.h>
#define DI03   0b1000
#define DI01   0b0010
main()
{
   if(( InputLevel & (DI03 | DI01)) == 0b0010)
 {
  H10 = 1;
 }
}
```

18.4 Querying an edge

18.4.1 Example 1

In addition to the level of an input terminal, the rising and falling edge can also be queries and evaluated. In the following sample programs, output DO02 is toggled to DI02 for a positive or negative edge.

Positive edge query

```
#include <const.h> // MOVIDRIVE A
#include <io.h>    // MOVIDRIVE A

// Variables for edge generation
long  lDI02RisingEdge,
        lDI02LastState,
        lDO02State,
        lInputLevel;

main()
{
 while(1)
 {
  // Read DI02
  lInputLevel = (InputLevel & 0x00000004);

  // Generate edge DI02
      lDI02RisingEdge = lInputLevel && (lDI02LastState);
  lDI02LastState = lInputLevel;

      if(lDI02RisingEdge)
      lDO02State = (!lDO02State)

      // Set output DO02
      if (lDO02State)
         _BitSet( StdOutpIPOS, 2 );

  else
         _BitClear( StdOutpIPOS, 2 );
 }
}
```

Negative edge query

```
#include <const.h>
#include <io.h>

// Variables for edge generation
long  lDI02FallingEdge,
        lDI02LastState,
        lDO02State,
        lInputLevel;

main()
{
 while(1)
 {
  // Read DI02
  lInputLevel = (InputLevel & 0x00000004);

  // Generate edge DI02
      lDI02FallingEdge = !lInputLevel && (lDI02LastState);
  lDI02LastState = lInputLevel;

      if(lDI02FallingEdge)
      lDO02State = (!lDO02State)

      // Set output DO02
      if (lDO02State)
         _BitSet( StdOutpIPOS, 2 );

  else
         _BitClear( StdOutpIPOS, 2 );
 }
}
```

INFORMATION

For When querying an edge, make sure to always use an auxiliary variable `lInput-Level` that stores the state of the input terminal instead of using the input terminal itself to create the edge.

```
                    // Read DI02
                    lInputLevel = (InputLevel & 0x00000004);

                    // Generate edge DI02
Edge change at DI02 lDI02FallingEdge = !lInputLevel && (!DI02LastState);
                    lDI02LastState = lInputLevel;
```

If the input terminal was used instead of the IInputLevel auxiliary variable, the edge at the input terminal could change at the point when the IPOS$^{plus®}$ program is between the two program lines required for edge creation. This would mean that the edge change would not be detected at the input terminal.

Also note that the edge of an input terminal can only be queried in the task in which the edge was created. If this is not the case, if the individual tasks are not synchronous, the edge may not be detected or it may be interpreted incorrectly.

If the edge of an input terminal is required in several tasks, the edge must be created separately in each task.

18.4.2 Example 2

In example 2, the program section within the if query is processed depending on the rising edge at DI02.

```
/*============================================
IPOS source file
============================================*/
#include <constb.h>
#include <iob.h>
long BinInputsNew, BinInputsOld;
/*============================================
Main function (IPOS initial function)
============================================*/
main()
 {
 /*-------------------------------------
 Initialization
 -------------------------------------*/
 /*-------------------------------------
 Main program loop
 -------------------------------------*/
 while(1)
  {
   // Reading binary inputs
   _GetSys( BinInputsNew,GS_INPUTS );
   // Querying an edge
   if( (BinInputsNew & 0x4) && !(BinInputsOld & 0x4) ) // rising edge DI02
    {
     // program statement is located here
    }

   // Saving input states
   BinInputsOld = BinInputsNew;
  }
 }
```

18.5 Value of a number

The following sample program demonstrates how the IPOS$^{plus®}$ Compiler can be used to create the absolute value of a number.

In task 1 a revision program is running that moves the drive relatively 400000 increments CW and 400000 increments CCW.

In task 2 the actual speed is read and the amount of the actual speed is created. The amount is stored in the variable `lActSpeedAbsolute`.

```
#include <constb.h>  // MOVIDRIVE A
#include <iob.h> // MOVIDRIVE B

#define SEKUNDE  1000

SSPOSSPEED tSpeed;
long lActSpeed, lActSpeedAbsolute;

/*==================================
Task 2
==================================*/
Task2()
{
 _GetSys( lActSpeed,GS_ACTSPEED );

 // Calculate absolute speed value
 if( lActSpeed < 0 )
 lActSpeedAbsolute = -lActSpeed;
 else
 lActSpeedAbsolute = lActSpeed;
}

main()
{
 // Initialization =================
 // Positioning speed 500 rpm
 tSpeed.CW = tSpeed.CCW = 5000;
 _SetSys( SS_POSSPEED,tSpeed );

 // Activate Task 2
 _SetTask2( T2_START,Task2 );

 // Main program loop ==============
 while(1)
 {
  _GoRel( GO_WAIT,400000 );
  _Wait( SEKUNDE );
  _GoRel( GO_WAIT,-400000 );
  _Wait( SEKUNDE );
 }
}
```

18.6 MoviLink command

The _MoviLink command exchanges data or parameters between units via SBus or RS-485. It is also possible to read or change internal unit parameters.

The following three examples are to illustrate the function of the _MoviLink command:

- Reading an internal unit parameter: The set reference travel type is read via _MoviLink.
- Writing a variable via SBus: If a MOVIDRIVE® unit is connected via SBus, variable H200 is written depending on the status of the binary input DI17.
- Reading a parameter via SBus: The process data configuration of the inverter connected by SBus is read with the address 10.

18.6.1 Reading an internal unit parameter

```
/*=======================================
Type of reference travel actually entered
in P903 is read in task 1 and written to
variable lRefType.
=======================================*/

/*=======================================
IPOS Source file
=======================================*/

#include <constb.h>
#include <iob.h>

// Definition of MOVLNK structures
MOVLNK tRefType;
MLDATA tData;

// Definition of Variables
long lRefType;

/*=======================================
Main program
=======================================*/

main()
{
 // Initialization of MoviLink for bus transfer
 tRefType.BusType   = ML_BT_S1;
 tRefType.Address = 253 // own inverter
 tRefType.Format    = ML_FT_PAR;    // only parameters
 tRefType.Service   = ML_S_RD;      // read
 tRefType.Index     = 8626;         // P903 RefType
 tRefType.DPointer  = numof(tData); // data buffer

 // Main program loop
 while(1)
 {
  // Read type of reference travel
  _MoviLink( tRefType );
  lRefType = tData.ReadPar;
 }
}
```

18.6.2 Writing a variable via SBus

```
/*=======================================
Variable H200 of inverter connected via
SBus is written depending on DI17 in task 1:
DI17 = 0 ->  -1000
DI17 = 1 ->  1000
=======================================*/

/*=======================================
IPOS Source file
=======================================*/

#include <constb.h>
#include <iob.h>

// Definition of MOVLNK structures
MOVLNK tBus;
MLDATA tBusData;

/*=======================================
Main program
=======================================*/

main()
{
 // Initialization of MoviLink for bus transfer
 tBus.BusType   = ML_BT_SBUS1;      // bus type SBus1
 tBus.Address   = 10;               // SBus address 10
 tBus.Service   = ML_S_WRV;  // write volatile
 tBus.Index     = 11200;            // variable H200
 tBus.DPointer  = numof(tBusData); // data buffer

 // Main program loop
 while(1)
 {
  if( DI17 )
  {
   tBusData.WritePar = 1000;
   _MoviLink( tBus );
  }
  else
  {
   tBusData.WritePar = -1000;
   _MoviLink( tBus );
  }
 }
}
```

18.6.3 Reading a parameter via SBus

```
/*=======================================
Process data configuration of inverter
connected via SBus is written to variable
lPDData in task 1.
The received values correspond to the
following process data configuration:
0 = PARAM + 1PD
1 = 1PD
2 = PARAM + 2PD
3 = 2PD
4 = PARAM + 3PD
5 = 3PD
6 = PARAM + 6PD
7 = 6PD
8 = PARAM + 10PD
9 = 10PD
=======================================*/

/*=======================================
IPOS Source file
=======================================*/

#include <constb.h>
#include <iob.h>

// Definition of MOVLNK structures
MOVLNK tPD;
MLDATA tData;

// Definition of variables
long lPDData;

/*=======================================
Main program
=======================================*/

main()
{
 // Initialization of MoviLink for bus transfer
 tPD.BusType   = ML_BT_SBUS;      // bus type SBus
 tPD.Address   = 10;              // SBus address 10
 tPD.Format    = ML_FT_PAR;       // only parameters
 tPD.Service   = ML_S_RD;         // read
 tPD.Index     = 8451;            // P090 PD data config
 tPD.DPointer  = numof(tData);  // data buffer

 // Main program loop
 while(1)
 {
  // Read PD configuration
  _MoviLink( tPD );
  lPDData = tData.ReadPar;
 }
}
```

18.7 SCOM communication

The following example shows a program that sends two variables cyclically every 10 ms via SBus. Another program receives the data that is sent.

With the `_SBusCommDef` command, you set up a data object for cyclical data transmission. The send object is described in the variable structure `tBusTr`, the receive object is described in `TBusRec`.

In order to start the cyclical data transmission, you have to call up the `_SBusCommOn` function for MOVIDRIVE® A and the `_SBusCommState` function for MOVIDRIVE® B.

18.7.1 Receiver

The receiver obtains the data from the SBus and stores it in the variables H305 and H306.

```
/*=========================================
Get data object 1025 from SBus and store
the data in variable H305 and H306.
SHELL settings:
P813 SBus Address ->  2
P816 SBus Baudrate ->  500 kBaud
=========================================*/

/*=========================================
IPOS Source file
=========================================*/

#include <constb.h>
#include <iob.h>

// Definition of SCOM structures
SCREC tBusRec;

// Definition of variables
#define Data_Var1x H305
#define Data_Var2x H306

/*=========================================
Main program
=========================================*/

main()
{
 // Initialization of SCOM transfer object
 tBusRec.ObjectNo   = 1060;              // object number
 tBusRec.Format     = 8;                 // 8 byte
 tBusRec.Dpointer  = numof(Data_Var1x);  // data buffer

 // Start SCOM
 _SBusCommDef( SCD_REC,tBusRec );
 _SBusCommState( SCS_START1 );   // Start cyclic communication MOVIDRIVE B
 // _SBusCommOn(  );   // Start cyclic communication MOVIDRIVE A

 // Main program loop
 while(1)
 {
 }
}
```

18.7.2 Sender

The variables H208 and H209 are transmitted cyclically every 10 ms to another inverter. The values of H208 and H209 can be changed using input DI17.

DI17 = 0: H208 = 111111 / H209 = 222222

DI17 = 1: H208 = 222222 / H209 = 444444

Task 2 is not implemented in this sample program.

```
/*=======================================
Variables H208 and H209 are sent cyclic
every 10 ms to another inverter via SBus.
The values of H208 and H209 can be altered
with input DI17.
DI17 = 0: H208 = 111111 / H209 = 222222
DI17 = 1: H208 = 222222 / H209 = 444444
SHELL settings:
P813 SBus Address ->  1
P816 SBus Baudrate ->  500 kBaud
=======================================*/
/*=======================================
IPOS Source file
=======================================*/
#include <constb.h>
#include <iob.h>

// Definition of SCOM structures
SCTRCYCL tBusTr;

// Definition of variables
#define Data_Var1 H208
#define Data_Var2 H209
/*=======================================
Main program
=======================================*/
main()
{
 // Initialization of SCOM transfer object
 tBusTr.ObjectNo   = 1025;              // object number
 tBusTr.CycleTime  = 10;                // cycle time
 tBusTr.Offset     = 0;                 // offset
 tBusTr.Format     = 8;                 // 8 byte
 tBusTr.DPointer   = numof(Data_Var1);  // data buffer
 tBusTr.Result     = 1111;              // default value for control

 // Initialize variables
 Data_Var1 = 111111;
 Data_Var2 = 222222;

 // Start SCOM
 _SBusCommDef( SCD_TRCYCL,tBusTr );
 _SBusCommState( SCS_START1 );   // Start cyclic communication MOVIDRIVE B
 // _SBusCommOn(  );   // Start cyclic communication MOVIDRIVE A
```

```
// Main program loop
while(1)
{
 if( DI17 )
 {
  Data_Var1 = 222222;
  Data_Var2 = 444444;
 }
 else
  Data_Var1 = 111111;
 {
  Data_Var2 = 222222;
 }
}
}
```

18.8 Touch probe interrupt processing

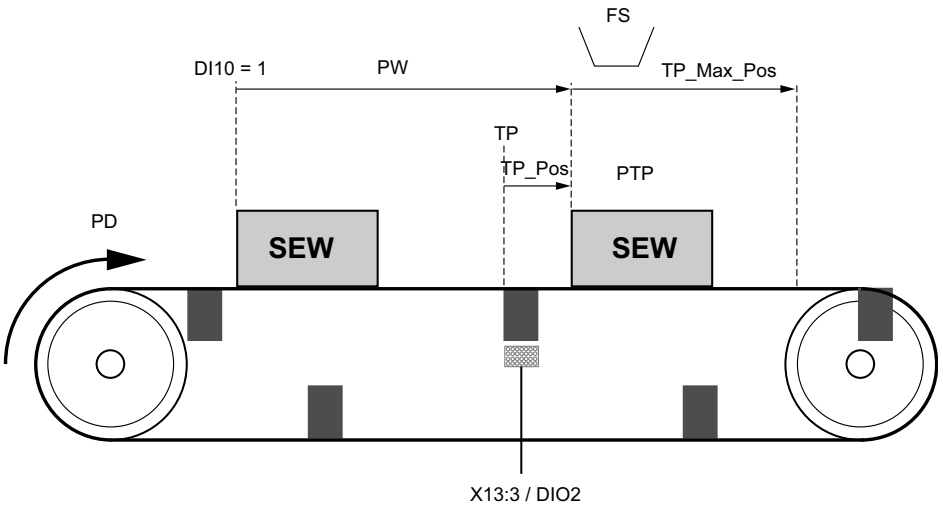
Crates are transported to a filling station on a timing belt. A proximity sensor (DI02) detects when the next crate arrives. This triggers an interrupt and the belt moves a specified remaining distance. The crate is then positioned directly under the filling station. Once the crate has been filled a new cycle is started.

Input DI10 must be active during the entire cycle. If DI10 = 0, the timing belt stops subject to position control. When the drive is restarted (DI10 = 1) it completes the cycle.

The position values, ramp and speed are entered in the variables H11 ... H14.

Variable	Name	Description
H11	TP_Max_Pos	Maximum target position if the touch probe input is not attenuated
H12	TP_Pos	Remaining travel after the touch probe input has been attenuated.
H13	Speed	Positioning speed in rpm.
H14	Ramp	Positioning ramp in ms.

Timing belt with proximity sensor:



506321163

PD: Pulse direction
DI10 = 1: Start
PW: Pulse width
FS: Filling station
TP_Max_Pos: Maximum target position
TP: TP event
TP_Pos: Remaining travel
PTP: Position after TP event
X13:3/DI02: proximity switch
SEW: Crate on conveyor belt

```
/
*============================================================================
Description:
A machine cycle is started via input DI10. The target position is the
current motor position (H511) plus TP_Max_Pos (H11). If the touch probe input
DI02
is not attenuated, the drive moves to this target position. If DI02 is attenu-
ated, a
new target position is calculated. The new target position is calculated from
the motor position
during the touch probe event TpPos1_Mot (H507) plus the remaining distance
TP_Pos (H12).
Settings in SHELL :
P601 Binary input DI02  IPOS input
P610 Binary input DI10  IPOS input
P700 Operating mode ... & IPOS
============================================================================*/
#include <const.h>
#include <io.h>
#define CALCTARGET              0
#define BUSSY                   1
#define STOP_AKTIV              2
#define State                   H10
#define TP_Max_Pos              H11
#define TP_Pos                  H12
#define Speed                   H13
#define Ramp                    H14
#define h473_ipos_in_position   (StatusWord & 0x00080000)   //StatusWord & BIT19
long lPosition;
```

```
SSPOSSPEED tPosSpeed;
SSPOSRAMP tPosRamp;
/*============================================
 Interruptroutine Touchprobe
============================================*/
Touchprobe()
 {
  lPosition = TpPos1_Mot + TP_Pos; //calculate new target position
  _TouchProbe( TP_DIS1 ); //Deactivate touch probe
 }
/*============================================
 Main function (IPOS initial function)
============================================*/
main()
{
 //Initialization
 State = 0;
 // Initialization of the interrupt routine for touch probe input DI02
 _SetInterrupt( SI_TOUCHP1,Touchprobe );
 //Main program loop
 while(1)
 {
// Set speed and ramp
   tPosSpeed.CW = tPosSpeed.CCW = Speed *10; // Speed
   tPosRamp.Up = tPosRamp.Down = Ramp; // Ramp
_SetSys (SS_POSRAMP, tPosRamp);
_SetSys (SS_POSSPEED, tPosSpeed);
  switch(State)
   {
   case CALCTARGET:     if(DI10)
        {
         lPosition = ActPos_Mot + TP_Max_Pos;
         _TouchProbe( TP_EN1_HI );
         // Activate rising edge
         State = BUSSY;
        }
        break;
   case BUSSY:     _GoAbs( GO_NOWAIT,lPosition );
        // _Go command to position
        if(h473_ipos_in_position && !DI10)
         // Axis in position and DI10 = 0
         State = CALCTARGET; // Calculate new target position
        if (!h473_ipos_in_position  && !DI10)
         // Positioning cancelled by DI10 = 0
        {
         _AxisStop(AS_PSTOP);
         State = STOP_AKTIV;
        }
        break;
   case STOP_AKTIV:     if(DI10) // DI10 = 1 -->  Continue positioning
        break;
         State = BUSSY;
default:     break;
  }//switch(State)
 }// while (1)
}// main
```

18.9 State machine, fieldbus control with emergency mode

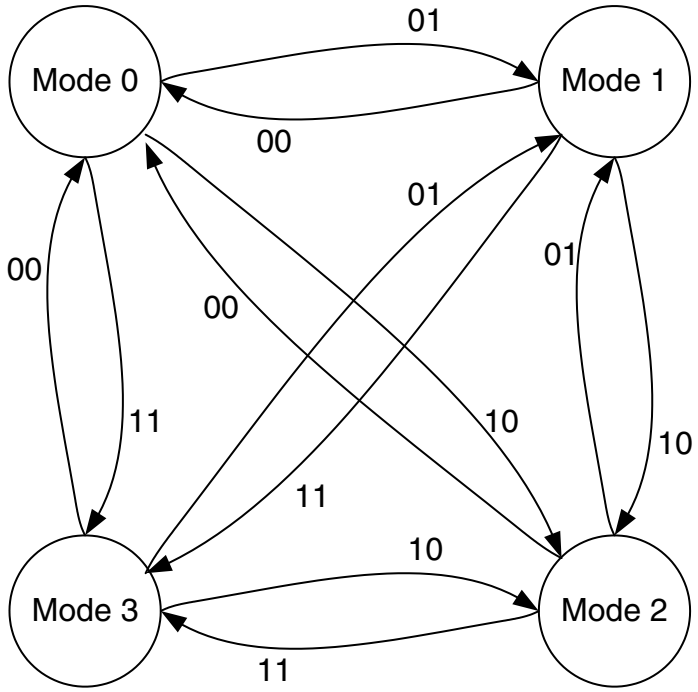
A drive is to be controlled via the fieldbus in normal mode. However, in the event of a bus fault, manual operation via terminal and analog value should be possible. Further, provisions have to be made for a mixed mode (fieldbus setpoint + analog setpoint). The operating mode is set using input terminals DI10 and DI11. The selected operating mode is to be displayed on outputs DO10 and DO11. The following operating modes should be provided:

INFORMATION

Use "IPOS" to assign PO data and base the control word on the ControlWord H484, otherwise there will be a problem in mode 2 if the bus fails.

The following status chart shows the transitions between the operating modes:

Chart of mode statuses:



506325259

```
/*=================================================
Operating mode is selected with input terminals
DI10 and DI11 and indicated at the outputs
DO10 and DO11.
The following operating modes are possible:
Mode 0: Control and setpoint via field bus
Mode 1: Control via field bus, setpoint added to
analog value 1
Mode 2: Control via terminals, setpoint analog 1
Mode 3: reserved

SHELL settings:
P100 Setpoint source: BIPOL./FIX.SETPT
P101 Control signal source: TERMINALS
P600 ... P604 Binary input DI01 ... DI05: NO FUNCTION
P610 / P611 Binary input DI10 / DI11: IPOS INPUT
P630 / P631 Binary output DO10 / DO11: IPOS OUTPUT
P700 Operating mode 1: ... & IPOS
P870 ... P872 Setpoint description PO1 ... PO3: IPOS PO-DATA
P873 ... P875 Actual value description PI1 ... PI3: IPOS PI-DATA
P876 PO data enable: ON
=================================================*/
/*=================================================
IPOS Source file
=================================================*/

#include <constb.h>
#include <iob.h>
#pragma globals 350 399

// Definition of structures
GSPODATA3 busdata;                  //structure for fieldbus process data
GSAINPUT analog;                    //structure for analog values

// Definition of variables
#define modeselect              ((InputLevel > >  6) & 0x00000003)
#define setfixedsetpoint        _SetSys( SS_N11,speed )
#define activatefixedsetpoint   _BitSet( ControlWord, 4 )
#define deactivatefixedsetpoint _BitClear( ControlWord, 4 )
#define enable                  _BitClear( ControlWord, 1 )
#define rapidstop               _BitSet( ControlWord, 1 )

// Declaration of variables
long mode, speed, offset;
```

```
/*=====================================================
Main program
=====================================================*/

main()
{
 // Initialization ==================================
 // Initialize data structure bus data
 busdata.BusType  = 3;          //bus type fieldbus
 busdata.Len = 3;
 busdata.PO1      = 0;
 busdata.PO2 = 0;
 busdata.PO3      = 0;
 // Activate task 2
 _SetTask2( T2_START,buscontrol );

 // Main program loop ===============================
 while(1)
 {
 }
}
/*=====================================================
Task 2
=====================================================*/

buscontrol()
{
 _GetSys( busdata,GS_PODATA );        //get bus data
 mode = modeselect;                   //read terminals for mode select
 OptOutpIPOS = ((OutputLevel > >  3) & 0xFFFFFFFC) ¦ mode;  //output mode
 switch( mode )
 {
case 0: mode_0();
   break;
case 1: mode_1();
   break;
case 2: mode_2();
   break;
case 3: mode_3();
   break;
 }
}
```

```
/*==================================================
Functions
==================================================*/

mode_0()
{
 if( busdata.PO1 == 6 )
  enable;
 else
  rapidstop;
  speed = busdata.PO2;
  setfixedsetpoint;
  activatefixedsetpoint;
}

mode_1()
{
 if( busdata.PO1 == 6 )
  enable;
 else
  rapidstop;
  _GetSys( analog,GS_ANINPUTS );
  offset = (analog.Input1 + 15) / 10;
  speed = busdata.PO2 + offset;
  setfixedsetpoint;
  activatefixedsetpoint;
}

mode_2()
{
 enable;
 deactivatefixedsetpoint;
}

mode_3()
{
 rapidstop;
}
```

18.9.1 Mode 0

Control and setpoint only via fieldbus

Control is performed exclusively via the fieldbus. A reduced control word (0 = rapid stop, 6 = enable) is also to be used. The setpoint is specified in bipolar terms via the fieldbus (-1500 rpm ... +1500 rpm).

18.9.2 Mode 1

Control via fieldbus, setpoint = fieldbus setpoint + analog setpoint

Control is performed exclusively via the fieldbus. A reduced control word (0 = rapid stop, 6 = enable) is also to be used. The setpoint is the sum of the fieldbus setpoint (bipolar –1500 rpm ... +1500 rpm) and the analog setpoint (–10 V ... +10 V = –1500 rpm ... +1500 rpm).

18.9.3 Mode 2

Control and setpoint via terminal or analog value.

The fieldbus is disabled.

18.9.4 Mode 3

Reserved

A rapid stop is performed until the mode is in use.

18.10 Compiler programming frame

The following sample program can be used as the basic frame when creating an IPOS$^{plus®}$ program. It includes a state machine with four operating modes:

- DISABLE: No operating mode is selected
- JOGGING: Jog mode
- HOMING: Reference travel
- POSITIONING: Positioning mode

```
/*====================================================================
   Name:       Basic_program
Version:    03/07/21 (Y/M/D)
Function:   Basic frame for an IPOS program with state machine
with entry and exit functions for control via
fieldbus or RS485 monitor with 3 I/O process data words

Settings required in SHELL:
------------------------------------------------------------
P100 = P101 = RS485 for simulation with bus monitor,
= comment FIELDBUS and "#define" for "//constants" for operation with fieldbus ???
P6xx = no functions, exception, e.g. P602 = REFERENCE CAM per reference travel type
P700        = xxx & IPOS
P870 = CONTROL WORD 2
P871        = IPOS PO DATA
P872 = IPOS PO DATA
P873        = STATUS WORD 1
P874        = IPOS PI DATA
P875 = IPOS PI DATA
P916        = e.g. to LINEAR
P960        = OFF (replace if <> OFF: ActPos_Mot =>  ModActPos and TargetPos =>  ModTagPos

Drive control via PLC / bus monitor (process output data)
-------------------------------------------------------------------------------
/DI00 = CONTROLLER INHIBIT

1. word = Control word 2
2. word = jog/positioning speed [1/10 rpm]
3. word = target position
Assignment of control word 2
15 14 13 12 11 10  9  8  7  6  5  4  3  2  1  0
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  Controller inhibit/Enable
|  |  |  |  |  |  |  |  |  |  |  |  |  |  Enable/Rapid stop
|  |  |  |  |  |  |  |  |  |  |  |  |  Enable/stop
|  |  |  |  |  |  |  |  |  |  |  |  Hold control
|  |  |  |  |  |  |  |  |  |  |  Integrator switchover
|  |  |  |  |  |  |  |  |  |  Parameter set switchover
|  |  |  |  |  |  |  |  |  Fault reset
|  |  |  |  |  |  |  |  Start reference travel
|  |  |  |  |  |  |  Jog +
|  |  |  |  |  |  Jog -
|  |  |  |  Operating mode bit 0,  01 = Jog, 10 = Referencing 11 = Automatic
|  |  |  Operating mode bit 1
```

```
Drive feedback to PLC/bus monitor (process input data)
------------------------------------------------------------------------------
1. word = status word, user-specific
2. word = actual speed [1/10 rpm]
3. word = actual position in incr. (only low word)
Assignment of status word, user-specific
15 14 13 12 11 10  9  8  7  6  5  4  3  2  1  0
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  not assigned
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  inverter ready
|  |  |  |  |  |  |  |  |  |  |  |  |  |  IPOS reference (drive referenced)
|  |  |  |  |  |  |  |  |  |  |  |  |  Target position reached
|  |  |  |  |  |  |  |  |  |  |  |  Brake released
|  |  |  |  |  |  |  |  |  |  |  Fault
|  |  |  |  Acknowledge operating mode bit 0,  01 = Jog, 10 = Referencing 11 = Automatic
|  |  |  Acknowledge operating mode bit 1 (note: AKTIVE BA is acknowledged.)
Brief intorduction to using the bus monitor:
1.) Start bus monitor in MOVITOOLS MotionStudio
2.) Click the button Set PO data
3.) In the left-hand field, click on the tab pages PO1, PO2, PO3 and enter the setpoints
4.) click the "send" button
------------------------------------------------------------------------------
This is sample software, the functionality is NOT guaranteed.
Users accept that in using the sample software they do so at their own risk. SEW does not guarantee
any specific performance.
==============================================================================*/
#include <const.h> //Default path: c:\program files\sew\movitools\projects\include
#include <io.h> //Integrate names of system variables and constants
//Define variable ranges
#pragma var H128 H149 // (Default range for Compiler aux.variables H400 H419)
#pragma globals H380 H449 // (Default range for global long variables H420 H449)
#pragma initials H0 H127 // (Default range for initials H0 H127)
#pragma list // Assembler code with comments
// Constants
#define MY_PD_LENGTH       3          //3 Fieldbus with process data
//#define MY_FBUS_TYPE     GS_BT_FBUS //GetSys to "Fieldbus" during operation
#define MY_FBUS_TYPE       GS_BT_S0   //for bus monitor GetSys to "RS485"
#define MY_HALT             13        //Position "Stop" in IPOS control word H484
// Bit masks
#define MY_OP_MODE           0x18 //virtual inputs DI13/14, InputLevel Bit 9/10
#define MY_READY_TO_RUN      (StatusWord & 0x4)  //Ready from H473
#define MY_NO_ERROR          (StatusWord & 0x2)  //1 = no fault, 0 = fault from H473
#define MY_IN_POSITION       (StatusWord & 0x80000) //IPOS drive has reached target position
#define MY_REFERENCED        (StatusWord & 0x100000) //Drive referenced
#define MY_START_HOMING      (lPA_ControlWordHigh & 0x1) //virt. terminal DI10 start reference travel
#define MY_START_POSITIONING (lPA_ControlWordHigh & 0x1) //virt. terminal DI10 start positioning
#define MY_JOG_PLUS          (lPA_ControlWordHigh & 0x2) //virt. terminal DI11 jog mode +
#define MY_JOG_MINUS         (lPA_ControlWordHigh & 0x4) //virt. terminal DI12 jog mode -
// Variables for setpoint/actual values, fieldbus control/status word
long lPA_ControlWordHigh; // Bits 8-15 of fieldbus control word 2
// =DI10 - DI17 of the virtual terminals = bits 6-13 in InputLevel (!!!)
SSPOSSPEED tPosVelocities; //Data structure for positioning speeds
long lPE_StatusWord;       // User status word, bit 8-15 of the fieldbus status word
// =DO10 - DO17 of the virtual terminals = Bit 0-7 in OptOutpIPOS (!!!)
long lActPosition,        // Actual position in incr
lScalingNumerator,   // Numerator for scaling the position
lScalingDenominator, // Denominator for scaling the position
lActVelocity;        // Actual speed in 1/10 rpm
```

```
// Variables for controlling operating modes
long lOpMode;              //Operating mode currently selected
long lGlobalStateMachine;  //Status of the global state machine
#define DISABLE       0    //global state machine: Status DISABLE
#define JOGGING       1    //global state machine: Status JOGGING
#define HOMING        2    //global state machine: Status HOMING
#define POSITIONING   3    //global state machine: Status POSITIONING
long lSubStateHoming;      //Substatus in main status "Homing"
#define HOMING_STOPPED 0
#define HOMING_STARTED 1
#define HOMING_READY   2
long lSubStatePositioning; //Substatus in main status "Positioning"
#define POSITIONING_STOPPED 0
#define POSITIONING_STARTED 1
// general variables
long lDriveState;         //Inverter status, corresponds to the 7-segment display of MDx
long lErrorCode;          //Error code
// Process data data structures
GSPODATA10 tPA;           //Output data (PLC -> Drive)
SSPIDATA10 tPE;           //Input data (Drive -> PLC)
/*============================================
Main function (IPOS initial function)
============================================*/
main()
{
 _WdOn( 5000 );  //Activate watchdog =>  in the event of error code 41
 while (!MY_READY_TO_RUN)
 { //max. 5000 ms wait until the inverter firmware is fully started up
 }
 _WdOff(  ); //Deactivate Watchdog startup
 /*-------------------------------------
 Initialization
 -------------------------------------*/

 // Initialize main state
 lGlobalStateMachine = 0;

 // Initialize scaling for the position
 lScalingNumerator = 1;
 lScalingDenominator = 1;

   // Initialize fieldbus variables for Getsys and Setsys commands
 tPA.BusType = MY_FBUS_TYPE; //Process data operation via source see above
 tPA.Len = tPE.Len = MY_PD_LENGTH; //PD length see above

 // Activate task2
 _SetTask2(T2_START, fnTask2); //To debug task 2, add inverse slashes here and delete them below
```

```
 /*-------------------------------------
 Main program loop
 -------------------------------------*/
 while(1)
 {
  //Process main state machine
  switch (lGlobalStateMachine)
  {
   // Either no operating mode has been selected, or a selection is not possible
   case DISABLE:
    break;
   // "Jog" mode
   case JOGGING: fnJogging();
    break;
   // "Referencing" mode
   case HOMING:fnHoming();
    break;
   // "Positioning" mode
   case POSITIONING: fnPositioning();
    break;
   //Programming error - invalid status
default: _AxisStop(AS_PSTOP);
lGlobalStateMachine = lOpMode = -1;
break;
  } // End switch (lGlobalStateMachine)
     } //End while (1)
} // End main
```

```
/*============================================
= Function: fnJogMode()
= Jog axis. With 2 inputs, the axis can be moved to the right and to the left.
= If the jog mode is not set, the drive remains in hold control. If the jog mode is activated when
the drive is released
= the main state machine would spring to state 99.
============================================*/
fnJogging()
{
   // Instructions for entering the main state "Jogging"
   // Acknowledge mode
   _BitSet(lPE_StatusWord,11);
   _BitClear(lPE_StatusWord,12);

   // cyclical processing as long as the main state is set to "Jogging"
   do
   {
      // Import PO data
      _GetSys( tPA.BusType ,GS_PODATA );

      if (MY_JOG_PLUS&&(!MY_JOG_MINUS))
      {
         tPosVelocities.CW = tPosVelocities.CCW = tPA.PO2;
         _SetSys( SS_POSSPEED, tPosVelocities );
         TargetPos = ActPos_Mot + 409600;
      }

      if (MY_JOG_MINUS&&(!MY_JOG_PLUS))
      {
         tPosVelocities.CW = tPosVelocities.CCW = tPA.PO2;
         _SetSys( SS_POSSPEED, tPosVelocities );
         TargetPos = ActPos_Mot - 409600;
      }

      if ((MY_JOG_MINUS && MY_JOG_PLUS)||((!MY_JOG_MINUS)&&(!MY_JOG_PLUS)))
         _AxisStop(AS_PSTOP);

   } while (lGlobalStateMachine==JOGGING);

   // Instructions for leaving the main state "Jogging"
   // Stopping the drive
   _AxisStop(AS_PSTOP);
   // Clear mode
   _BitClear(lPE_StatusWord,11);
   _BitClear(lPE_StatusWord,12);

}// end fnJogging()
```

```
/*============================================
= Function: fnHoming()
= Axis reference travel
= Parameters of the group 97x are effective
= A positive edge on REF-START starts a new reference travel
============================================*/
fnHoming()
{
   // Instructions for entering the main state "Homing"
   // Define substate
   lSubStateHoming = HOMING_STOPPED;
   // Acknowledge mode
   _BitClear(lPE_StatusWord,11);
   _BitSet(lPE_StatusWord,12);

   // cyclical processing as long as the main state is set to "Homing"
   do
   {
      // Import PO data
      _GetSys( tPA.BusType ,GS_PODATA );

      switch (lSubStateHoming)
      {
         case HOMING_STOPPED: if (MY_START_HOMING)
                              {
                                 _Go0(GO0_U_NW_CAM);
                                 lSubStateHoming = HOMING_STARTED;
                              }
                              break;
         case HOMING_STARTED: if (!MY_START_HOMING)
                              {
                                 _Go0(GO0_RESET);
                                 lSubStateHoming = HOMING_STOPPED;
                              }
                              if (MY_REFERENCED)
                              {
                                 lSubStateHoming = HOMING_READY;
                              }
                              break;
         case HOMING_READY:   if (!MY_START_HOMING)
                              {
                                 lSubStateHoming = HOMING_STOPPED;
                              }
                              break;
      }
 } while (lGlobalStateMachine==HOMING);
 // Instructions for leaving the main state "Homing"
 // Stopping the drive
 if (lSubStateHoming==HOMING_STARTED)
 {
   _Go0(GO0_RESET);
   lSubStateHoming = HOMING_STOPPED;
 }
 // Clear mode
 _BitClear(lPE_StatusWord,11);
 _BitClear(lPE_StatusWord,12);

}// End fnHoming
```

```
/*============================================
= Function: fnPositioning()
= Positioning
============================================*/
fnPositioning()
{
   // Instructions for entering the main state "Positioning"
   // Define substate
   lSubStatePositioning = POSITIONING_STOPPED;
   // Acknowledge mode
   _BitSet(lPE_StatusWord,11);
   _BitSet(lPE_StatusWord,12);

   // cyclical processing as long as the main state is set to "Positioning"
   do
   {
      // Import PO data
      _GetSys( tPA.BusType ,GS_PODATA );

      switch (lSubStatePositioning)
      {
         case POSITIONING_STOPPED:  if (MY_START_POSITIONING)
                                    {
                                       tPosVelocities.CW = tPosVelocities.CCW = tPA.PO2;
                                       _SetSys( SS_POSSPEED, tPosVelocities );
                                       TargetPos = (lScalingNumerator * tPA.PO3)
                                          / lScalingDenominator;
                                       lSubStatePositioning = POSITIONING_STARTED;
                                    }
                                    break;
         case POSITIONING_STARTED:  if (MY_START_POSITIONING)
                                    {
                                       tPosVelocities.CW = tPosVelocities.CCW = tPA.PO2;
                                       _SetSys( SS_POSSPEED, tPosVelocities );
                                       TargetPos = (lScalingNumerator * tPA.PO3)
                                          / lScalingDenominator;
                                    }
                                    else
                                    {
                                       _AxisStop(AS_PSTOP);
                                       lSubStatePositioning = POSITIONING_STOPPED;
                                    }
                                    break;
      }
   }while (lGlobalStateMachine==POSITIONING);

   // Instructions for leaving the main state "Positioning"
   // Stopping the drive
   if (lSubStatePositioning==POSITIONING_STARTED)
      _AxisStop(AS_PSTOP);
      // Clear mode
      _BitClear(lPE_StatusWord,11);
      _BitClear(lPE_StatusWord,12);

}// End fnPositioning()
```

```
/*============================================
= Function: fnTask2()
= For time-critical program sections that can run asynchronously
= from task one
=
============================================*/
fnTask2()
{

   // Read inverter state
   _GetSys( lDriveState,GS_SYSSTATE );
   // Read error number
   _GetSys( lErrorCode,GS_ERROR );
   // Import PO data
   _GetSys( tPA.BusType ,GS_PODATA );

   // Create branch distributor/ Select operating mode
   // Virtual fieldbus terminal can only be used if a DIO or DIP is not inserted
   // in this case, use "lPA_ControlWordHigh   = tPA.PI1 > >  8;"
   // otherwise "lPA_ControlWordHigh   = InputLevel > >  9;" //Move Bit0 to Bit 0
   lPA_ControlWordHigh   = tPA.PO1 > >  8; //Move Bit8 to Bit 0
   lOpMode = (lPA_ControlWordHigh & MY_OP_MODE )> >  3; //Bit 3,4 = Operating mode

   // Create status transitions
   switch (lGlobalStateMachine)
   {
      // Either no operating mode has been selected, or a selection is not possible
      case DISABLE:  if (lDriveState> =0xA)
                     {
                        if (lOpMode==JOGGING)
                           lGlobalStateMachine = JOGGING;
                        if (lOpMode==HOMING)
                           lGlobalStateMachine = HOMING;
                        if (lOpMode==POSITIONING)
                           lGlobalStateMachine = POSITIONING;
                     }
                     break;
      // "Jog" mode
      case JOGGING:  if (lDriveState> =0xA)
                     {
                        if (lOpMode==DISABLE)
                           lGlobalStateMachine = DISABLE;
                        if (lOpMode==HOMING)
                           lGlobalStateMachine = HOMING;
                        if (lOpMode==POSITIONING)
                           lGlobalStateMachine = POSITIONING;
                     }
                     else
                        lGlobalStateMachine = DISABLE;
                     break;
```

```
   // "Referencing" mode
   case HOMING:   if (lDriveState> =0xA)
                  {
                     if (lOpMode==JOGGING)
                        lGlobalStateMachine = JOGGING;
                     if (lOpMode==DISABLE)
                        lGlobalStateMachine = DISABLE;
                     if (lOpMode==POSITIONING)
                        lGlobalStateMachine = POSITIONING;
                  }
                  else
                     lGlobalStateMachine = DISABLE;
                  break;
   // "Positioning" mode
   case POSITIONING:if ((lDriveState> =0xA)&&(MY_REFERENCED))
                  {
                     if (lOpMode==JOGGING)
                        lGlobalStateMachine = JOGGING;
                     if (lOpMode==HOMING)
                        lGlobalStateMachine = HOMING;
                     if (lOpMode==DISABLE)
                        lGlobalStateMachine = DISABLE;
                  }
                  else
                     lGlobalStateMachine = DISABLE;
                  break;
   //Programming error - invalid status
   default:       _AxisStop(AS_PSTOP);
                  lGlobalStateMachine = lOpMode = -1;
                  break;
 }// End switch (lGlobalStateMachine)

 //Regenerate process input data and send to PLC
 fnBuildStatusWord();  //Create status word

 _GetSys(lActVelocity,GS_ACTSPEED); //Read actual speed
 tPE.PI2 = lActVelocity;            // Output actual speed

 lActPosition = ActPos_Mot; // Actual position
 tPE.PI3 = (lScalingDenominator * lActPosition) / lScalingNumerator; //Actual position

 _SetSys(SS_PIDATA, tPE.Len); //Send PD
}
/*============================================
= Function: fnBuildStatusWord()
= Here, bit 0-7 of the status word is generated
= if an error occurs, the other outputs are
= replaced by the error code.
============================================*/
fnBuildStatusWord()
{
 _BitMove(lPE_StatusWord,1, StatusWord,2); //Inverter ready
 _BitMove(lPE_StatusWord,2, StatusWord,20); //IPOS referenced
 _BitMove(lPE_StatusWord,3, StatusWord,19); //Target position reached
 _BitMoveNeg(lPE_StatusWord,4, StatusWord,1); //Error
 if ( !MY_NO_ERROR )
 { // if an error occurs, overwrite the status bits of the operating modes with the error code

  lPE_StatusWord = lPE_StatusWord & (lErrorCode << 8);
 }
 tPE.PI1 = lPE_StatusWord ;
}//end fnBuildStatusWord()
```

19 Compiler – Error Messages

The source text errors that are recognized by the pre-processor and the Compiler are divided into error classes and error codes.

Error class	Error code	Possible cause
STATEMENT	NOT FOUND SEMICOLON	Statements missing from body of loop Semicolon missing after statement
CONDITIONAL	COLON	Colon ":" missing from conditional statement
BLOCK	END	Block without closing bracket " }"
BREAK	SEMICOLON	Semicolon ";" missing after break
CASE	ILLEGAL TYPE COLON DEFAULT	Case must be followed by constant Case constant must be followed by colon Default branch contains error(s) or is in wrong position
COMPILER	Error text	Internal system error (contact SEW)
CONTINUE	SEMICOLON	Semicolon ";" missing after continue
DECLARE	IDENTIFIER NO VARIABLE TOO MANY #DEFINE	Identifier after #declare is invalid #declare must describe a variable Number of #define exceeds resources
DEFINE	IDENTIFIER SYMBOL SEQUENCE TOO MANY #define	Identifier after #define is invalid Symbol sequence after #define is invalid Number of #define exceeds resources
DO	WHILE OPEN BRACKET CLOSE BRACKET SEMICOLON	while is missing after do statement Open round bracket "(" missing after while Close round bracket ")" missing after while Semicolon ";" missing after while
FACTOR	CLOSE BRACKET	Close bracket ")" missing after expression in brackets
FCT.CALL	CLOSE BRACKET NUMBER ARGS	Close bracket ")" missing after function name The number of arguments is incorrect
FOR	OPEN BRACKET SEMICOLON CLOSE BRACKET	Open round bracket "(" missing after for Semicolon ";" missing between for expressions Close round bracket ")" missing after for
FUNCTION	OPEN BRACKET CLOSE BRACKET	Round bracket(s) missing for function declaration.
IDENTIFIER	NOT FOUND	Unknown identifier
IF	OPEN BRACKET CLOSE BRACKET	Open round bracket "(" missing after if Close round bracket ")" missing after if
CONSTANT	ILLEGAL TYPE	Syntax of dec., binary or hex constant is incorrect
PRAGMA	IDENTIFIER VARIABLE RANGE	Invalid keyword after #pragma Variable range is not permitted
PREPROCESSOR	NO VARIABLE TOO MANY #include SOURCE TEXT TOO LONG HEADER FILE NAME OPEN FILE CLOSE FILE LINES TOO LONG	Variable name must follow numof Too many #include directives nested Source text exceeds maximum permitted length Invalid header file name File cannot be opened Unexpected file end reached Source text row too long
RETURN	SEMICOLON	Semicolon ";" missing after return
SWITCH	OPEN BRACKET CLOSE BRACKET	No open round bracket "(" after switch or open bracket "{" missing from block Close round bracket ")" missing after switch and close brackets "}" missing after block
UNDEF	IDENTIFIER	Identifier after #undef is invalid
WHILE	OPEN BRACKET CLOSE BRACKET	Open round bracket "(" missing after while Close round bracket ")" missing after while

20 Assembler – Introduction

20.1 Setting the user travel units

In the program header of the Assembler, the travel distance factors "NUMERATOR", "DENOMINATOR" and "UNIT" can be entered to determine the user travel unit (e.g. mm, rev.).

20.1.1 Travel distance factors NUMERATOR/DENOMINATOR

IPOS$^{plus®}$ always operates with 4096 increments/motor revolution The user may wish to program travel commands in user units other than increments/motor revolution (e.g. mm, revs.). In this case, the "NUMERATOR" and "DENOMINATOR" travel distance factors must be set as described below. Exceptions to this are travel commands with variables as their argument. These can only be specified in increments/motor revolution.

The conversion is carried out as follows:

$$\text{Increments} = \frac{\text{NUMERATOR}}{\text{DENOMINATOR}} \cdot \text{User travel unit}$$

	INFORMATION If the numerator or denominator are non-integer values, the conversion can be made more accurate if both numerator and denominator are multiplied by the same expansion factor (e.g. 10, 100, 1000, etc.). Doing so will not limit the travel range.

Travel distance factor NUMERATOR

Number of increments the motor moves to travel a defined distance.

Setting range: 0 ..... **1** ..... 2^{31} - 1

Travel distance factor DENOMINATOR

Defined travel distance in user travel units.

Setting range: 0 ..... **1** ..... 2^{31} - 1

Example

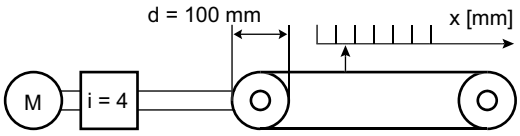
12376 increments correspond to 120 mm. NUMERATOR = 12376, DENOMINATOR = 120, UNIT = mm.

Example

The following three examples will demonstrate how the travel factors numerator/denominator of a linear unit are set for position specification:

- Example A: Position specification in mm for the linear axis
- Example B: Position specification in increments
- Example C: Position specification in output revolutions

Mechanical structure of the linear unit



511398411

Example A: mm

The defined distance to be calculated is one revolution of the driven gear.

- Travel distance factor NUMERATOR = Increments/motor revolution × gear ratio i = 4096 × 4 = 16384
- Travel distance factor DENOMINATOR = Output diameter × π = 314.15926

The travel distance factor DENOMINATOR is not a whole number, so the accuracy of the conversion can be increased by using an expansion factor. The expansion factor should be as high as possible, however, the result must not exceed the setting range (expansion factor e.g. 100 000).

- Travel distance factor NUMERATOR = 16384 × 100000 = 1638400000
- Travel distance factor DENOMINATOR = 314.15926 × 100000 = 31415926

	INFORMATION Since π is not a finite number, the target position specification will always contain errors.

Example B: Increments

- Travel distance factor NUMERATOR = 1
- Travel distance factor DENOMINATOR = 1

Example C: Output revolutions

- Travel distance factor NUMERATOR = Increments/motor revolution × gear ratio i = 4096 × 4 = 16384
- Travel distance factor DENOMINATOR = 1

Practical information

Practical information for determining the travel distance factor during startup.

e.g. setting the user travel units in mm.

1. Set both the travel distance factors NUMERATOR and DENOMINATOR to the value 1 (→ user travel units = increments).
2. Optional number of user travel units (increments), e.g. 100 000 increments.
3. Measure the covered distance in point 2 of the plant e.g.:
   - Starting position = 1000 mm
   - Target position = 1453 mm
   - Distance covered = 453 mm
4. Enter the travel distance factors in the program header of the Assembler:
   - Travel distance factor NUMERATOR = 100 000
   - Travel distance factor DENOMINATOR = 453

20.1.2 UNIT

All travel distance entries are displayed with a unit in the program window.

This unit can be entered in the program header for UNIT. It can be up to five characters in length.

	INFORMATION This is a merely symbolic entry that does not affect the functionality of the drive

20.2 First steps

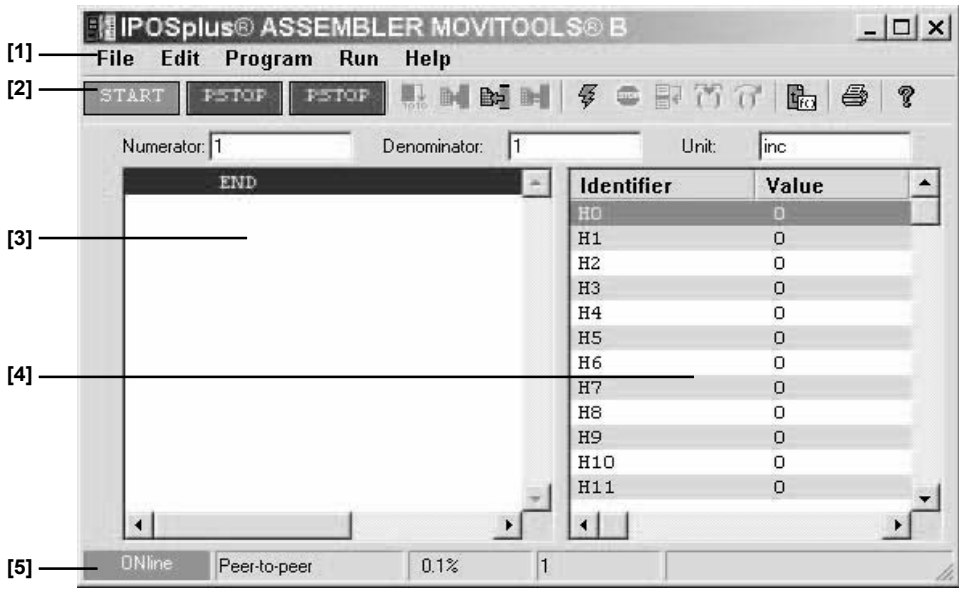
20.2.1 Starting the IPOS$^{plus®}$ Assembler

The IPOS$^{plus®}$ Assembler is started from the MOVITOOLS® MotionStudio.

- Start the IPOS$^{plus®}$ Assembler just like you would start the IPOS$^{plus®}$ Compiler.

  Refer to section: "Step 1: Starting the IPOS$^{plus®}$ Compiler with MOVITOOLS MotionStudio® (page 143)"

The following program interface is displayed when you start the IPOS$^{plus®}$ Assembler.

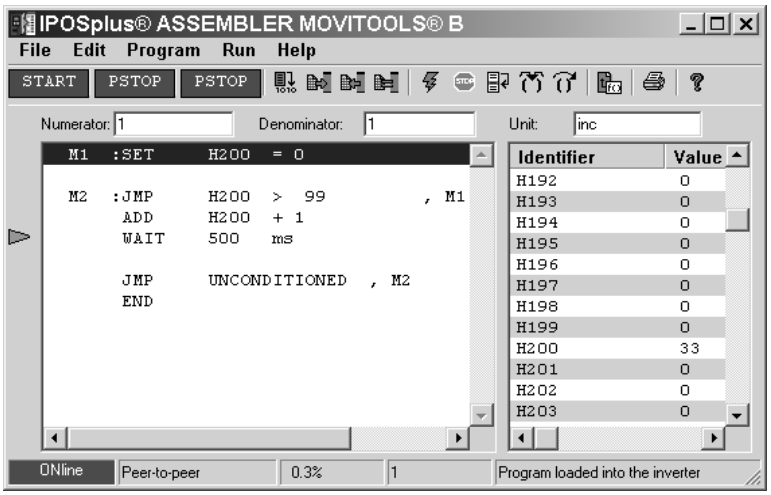


511471115

[1] Menu bar
[2] Toolbar
[3] Program window
[4] Variable window
[5] Status bar

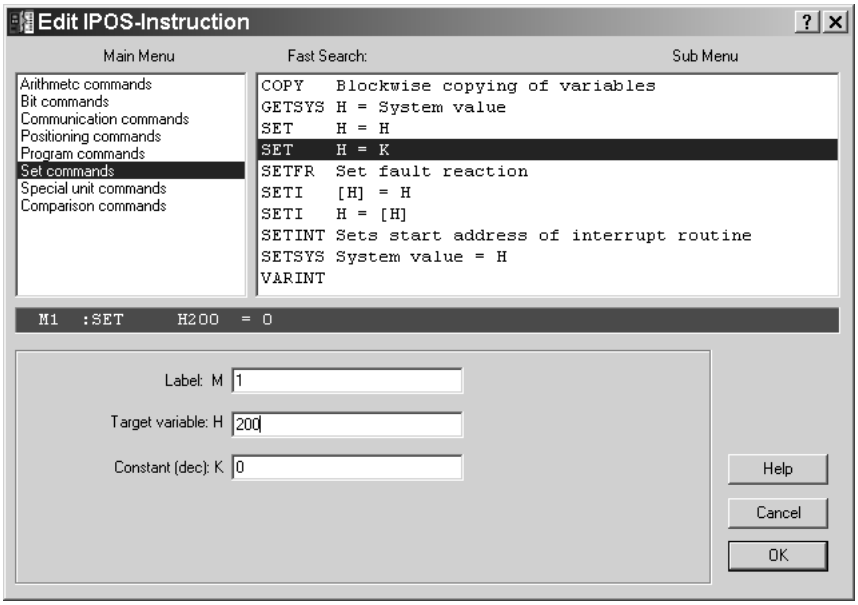
20.2.2 Creating a new program

To familiarize yourself with the IPOS$^{plus®}$ Assembler you will write your first program to increment a variable from 0 to 99 in steps of 500 ms.



511514635

Assembler commands are entered using the insert tool. To open the dialog box of the insert tool, click the icon .



511519755

To insert the first Assembler command in the program, in the [main menu] window, click on [Set commands] and choose "SET H = K" from the window on the right.

In the lower section of the dialog box, enter the jump label of the command line, the target variable and the value (constant) to which the variable should be set. Click on [OK] to close the insert tool and insert the command in the program.

Now use the insert tool to insert the remaining commands in the program. The following table lists the parameters for all the program commands. If you need information on a command, highlight it and press the <F1> key.

Command	Label	Target	Condition	Constant	Destination
SET	1	200		0	
JMP	2	200	>	99	1
ADD		200		1	
WAIT				500	
JMP			UNCONDI-TIONED		2

20.2.3 Compiling and starting the program

To generate an Assembler program in a form that the inverter can understand, the source code must be compiled.

To do so, choose [Program]/[Compile] or click on the icon in the toolbar.

If the program is compiled successfully, this information is displayed in the status bar.

511550475

As the next step, the compiled program must be loaded into the inverter. To do so, choose [Program]/[Compile + download] or click on the icon in the toolbar.

The status bar shows whether the program has been downloaded successfully.

511552011

The IPOS$^{plus®}$ program is now stored in the unit's non-volatile memory.

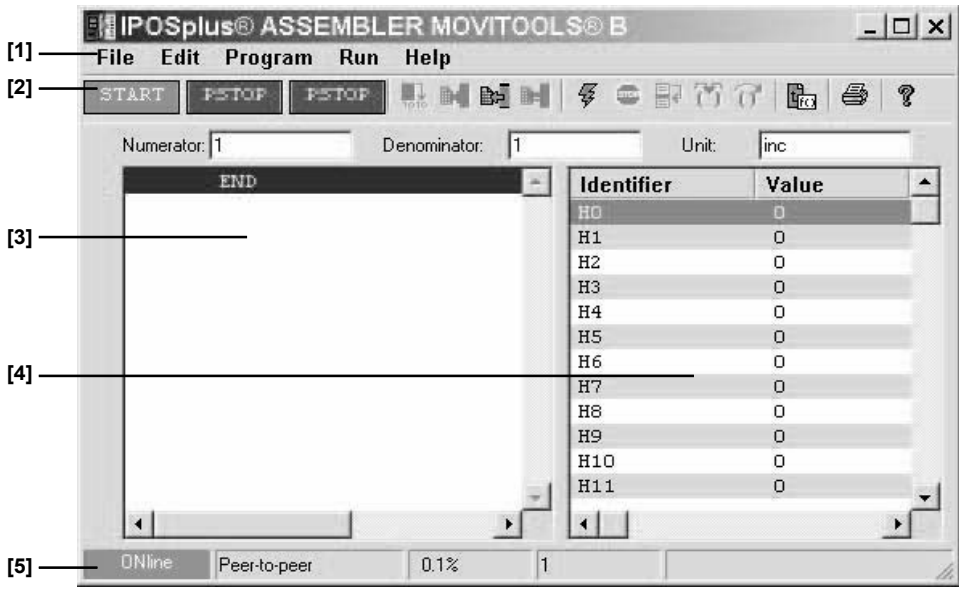
IPOS$^{plus®}$ programs can also be downloaded from one MOVIDRIVE® to another MOVIDRIVE® using a DBG60B/DBG11B keypad. This is done using parameters P807 (Copy MDX -> DBG) and P806 (Copy DBG -> MDX).

A program can be started once it has been downloaded to the inverter. Choose [Run]/[Start]. Alternatively, you can click on the icon in the toolbar. Once the program has been started, a green arrow (program pointer) is displayed in the project window to highlight the program line currently being processed. The display in the toolbar changes from PSTOP to START.

To stop the programs in task 1, task 2 and task 3, choose [Run]/[Stop] from the menu bar. Alternatively, you can click on the icon in the toolbar. Once the program has been stopped (all tasks), the program pointer turns red and remains in the first command line of task 1. The status display for the program sequence in the tool bar changes from START to PSTOP.

21 Assembler – Editor

The Editor is displayed after the IPOS$^{plus®}$ Assembler has been started:



511872523

[1] Menu bar
[2] Toolbar
[3] Program window
[4] Variable window
[5] Status bar

The status bar shows whether the unit is online or offline. It also displays the program memory content as a percentage and the number of program lines selected.

There are three input fields under the toolbar:

- Numerator
- Denominator
- Unit

Position setpoints can be scaled using the numerator/denominator ratio, which means that they can be specified in units defined by the user. Positions specified via variables cannot be scaled using this ratio.

21.1 Example

The encoder of a motor supplies 4096 increments per revolution. There is a spindle on the motor with a slope of 10 mm/revolution that moves a trolley horizontally.

The user wants to specify the positions to which the drive is to move in mm.

In this case, set the numerator and denominator as follows.

- Numerator: 4096
- Denominator: 10
- Unit: mm

When you insert a positioning command, you can now enter the required position in mm, as long as the value is a constant.

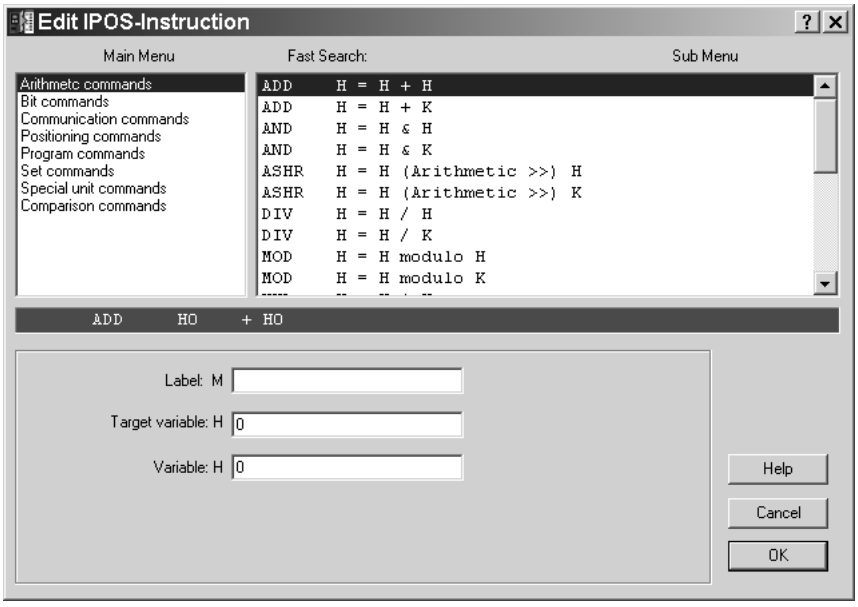
The operating states of the user programs task 1, task 2 and task 3 are:

- START (program is running)
- PSTOP (Program stopped);
- BREAK (program is only processed up to the marked line)
- STEP (program is processed line-by-line by pressing the F7 key).

21.2 Creating programs

21.2.1 Inserting command lines

Open the insert tool by clicking the icon, by pressing the <Ins> key or by choosing [Edit]/[Insert command...] from the menu bar.



511877899

All commands available in IPOS$^{plus®}$ can be selected in the insert tool.

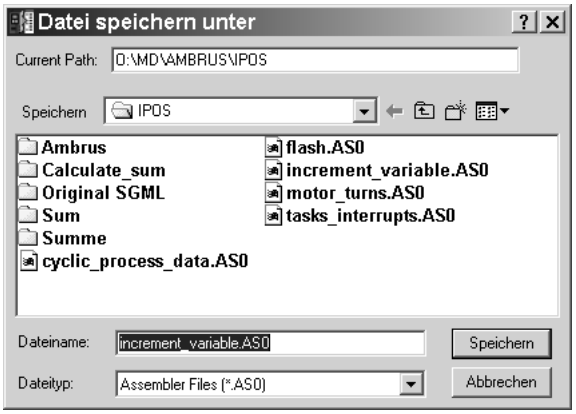
When you select a command, an input screen appears in which you have to enter the arguments available for the selected function. Once you have entered all the arguments, press [OK] to insert the command in the program.

You can use the <Del> key to remove selected command lines from the program.

In the same way, you can insert entire command blocks by highlighting the required section with the mouse and choosing [Edit]/[Copy] and [Edit]/[Insert] or delete them by choosing [Edit]/[Cut].

You can change an inserted command by double-clicking the command line in the project window or by choosing [Edit]/[Edit command...] from the menu bar.

Save the compiled Assembler program by choosing [File]/[Save...].



511934475

In MOVIDRIVE® A, Assembler programs are saved with the extension *.MDX. In MOVIDRIVE® B they are saved with the extension *.AS0. In the dialog box, enter the name and directory of the Assembler program.

	INFORMATION MDX files created using the Assembler only contain program code and no parameters. MDX files, created for storing parameters using SHELL, contain both parameters and program code. Therefore, you must be careful when overwriting existing MDX files.

21.3 Compiling and downloading

To generate an Assembler program in a form that the inverter can understand, the source code must be compiled.

To do so, choose [Program]/[Compile] or click on the icon in the toolbar.

If the program is compiled successfully, this information is displayed in the status bar.

511940235

As the next step, the compiled program must be loaded into the inverter. To do so, choose [Program]/[Compile + download] or click on the icon in the toolbar.

The status bar shows whether the program has been downloaded successfully.

512034955

The IPOS$^{plus®}$ program is now stored in the unit's non-volatile memory.

IPOS$^{plus®}$ programs can also be downloaded from one MOVIDRIVE® to another MOVIDRIVE® using a DBG keypad. This is done using parameters P807 (Copy MDX -> DBG) and P806 (Copy DBG -> MDX).

21.4 Starting/stopping programs

A program can be started once it has been downloaded to the inverter. Choose [Run]/[Start] or the. icon in the toolbar. Once the program has been started, a green arrow (program pointer) is displayed in the project window to highlight the program line to be processed. The display in the toolbar changes from PSTOP to START.

To stop the programs in task 1, task 2 and task 3, choose [Run]/[Stop] or the icon in the toolbar. Once the program has been stopped the program pointer turns red and remains in the first command line. The status display for task 1, task 2, and task 3 in the toolbar changes from START to PSTOP.

21.4.1 Variable window

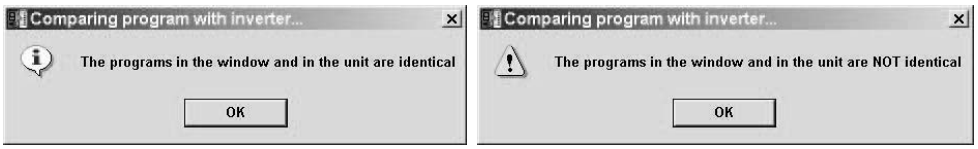
All variables and their content are displayed in the variable window. Double-click on a variable to change the contact of the variable directly using the keyboard. Press the Enter key to adopt the new value.

21.5 File/unit comparison

Use the comparison function of the IPOS$^{plus®}$ Assembler to compare an Assembler program loaded in the Editor window with a program loaded in the inverter.

To call the comparison function, choose [Program]/[Compare with inverter] or click on the icon in the toolbar.

If the programs match, the dialog box on the left below will be displayed. If the programs do not match, the dialog box on the right will be displayed.


Comparing program with inverter...
The programs in the window and in the unit are identical
OK
Comparing program with inverter...
The programs in the window and in the unit are NOT identical
OK

512040331

21.6 Debugger

The integrated debugger is a tool used to run through a program in single step mode. Once the program has been downloaded to the inverter, you can choose from three functions.

21.6.1 Execute to cursor

Choose [Run]/[Run to cursor] or the icon in the toolbar to run the program up to the current cursor position.

21.6.2 Single step

Choose [Run]/[Single step] or the icon in the toolbar to process the program line in which the cursor is currently positioned.

Choose [Run]/[Skip] or the icon in the toolbar to skip the program line in which the cursor is currently positioned. The cursor jumps to the next program line. This function is helpful if you want to skip function calls in a program for test purposes.

You can start the program by clicking the icon in the tool bar, function key F5 or the [Stop] menu command from the [Run] menu in the menu bar can be used to stop and reset the program at any time during debugging.

Click the icon from the toolbar or choose [Run]/[Start] form the menu bar to start the program from the current cursor position at any time during the debugging process.

You can interrupt a running program by pressing [Alt+F5]. The execution bar is now positioned at the command that is to be executed next.

The program can also be interrupted by pressing the F4 key [Run to cursor]. The program is stopped in the command line in which the cursor is positioned.

21.7 Loading the program from the inverter

In the IPOS$^{plus®}$ Assembler you have the option of uploading a program stored in the inverter. To do so, choose [Program]/[Upload] or click on the icon in the toolbar. The upload process deletes the previous Assembler program that you had open.

Remark lines are not saved in the inverter and as a result are lost during the upload process.

21.8 Overview of the icons

The functions that can be called up from the tool bar are listed below:

Symbol	Menu item	Description
	File -> open	Opens a program
	File -> save	Saves a program
	Program -> compile	Compiles a Program
	Program -> Compile + download	Compiles a program and downloads it into the inverter
	Program -> Upload	Uploads a program from the inverter
	Program -> compare with unit	Compares program in the editor with the program in the inverter
	Run -> Start	Starts the IPOS$^{plus®}$ program
	Run -> stop	Stops the IPOS$^{plus®}$ program
	Run -> run to cursor	Runs program to where the cursor is positioned
	Run -> single step	Runs single step
	Run -> skip	Skips an instruction (statement)
	Edit -> Insert command	Calls insert tool
	File -> Print	Prints a program
	Help -> user manual	Open online help

22 Assembler – Programming

22.1 Basics

The IPOS$^{plus®}$ Assembler is part of the MOVITOOLS® MotionStudio program package. The Assembler program is entered over a number of screens.

22.1.1 Program header

For user programs in which positioning commands are used, enter the user travel units in the program header.

22.1.2 Task 1 / Task 2 / Task 3

The IPOS$^{plus®}$ positioning and sequence control system allows a user program to be spilt into 3 subroutines (task 1 / task 2 / task 3) which can run in parallel and independently of one another.

22.1.3 Comments

Like command lines, you can insert comments anywhere in the user program.

Remarks can only be saved on the PC; they are not transferred when the program is downloaded to the inverter.

22.1.4 Program branches

Program branches are possible with jump flags (M...) in conjunction with jump commands (JMP... M...). Jump flags can be inserted before any command line.

22.1.5 Subroutine system

Subroutines can be called with a CALL command (CALL M...). The corresponding jump flags (M...) are inserted before the first command of the subroutine. A subroutine ends with a return command (RET). The return command causes program processing to jump back to the line below the CALL command. The following program lines will then be processed. Nested subroutines are possible; but a maximum of 16 layers should not be exceeded.

	INFORMATION Do not exit subroutines by jumping to a main program or another subroutine. If a subroutine is to be exited conditionally, this must be done by jumping to the end (RET) of the subroutine.

22.1.6 Program loops

Program loops consist of a loop start (LOOPB) and a loop end (LOOPE). The number of loop cycles is determined in the argument of the LOOP command. Nested loops are possible; but a maximum of 16 layers should not be exceeded.

	INFORMATION Do not exit program loops with a jump command. Jump commands are allowed within a program loop.

22.1.7 Positioning commands

The IPOS$^{plus®}$ positioning enables you to perform point-to-point positioning with MOVIDRIVE® and MOVIDRIVE®*compact* drives.

22.1.8 Binary/analog inputs/outputs

Binary and analog inputs/outputs are processed with variables. Furthermore, binary inputs can be evaluated directly using a jump command.

22.1.9 Access to system values/parameters

The drive parameters listed in the section "IPOS$^{plus®}$ Parameters" as arguments for the GETSYS and SETSYS commands are referred to below as system values. These system values can be used as follows:

- Read with the **GETSYS** command, e.g. active current and actual speed.
- Reading via PO data items.
- Writing with the **SETSYS** command, e.g. fixed setpoint.
- Writing fieldbus data via PI data items.
- System values can also be read and written using the system variables H458 ... H511 for MOVIDRIVE® A / H458 ... H560 for MOVIDRIVE® B.
- The **MOVLNK** command enables you to change all parameters of the directly connected inverter or to exchange parameters with other inverters via RS-485.
- The **MOVLNK** command enables you to change all parameters of the MQX and MOVIMOT® or to exchange parameters with other inverters via SBus or RS-485.

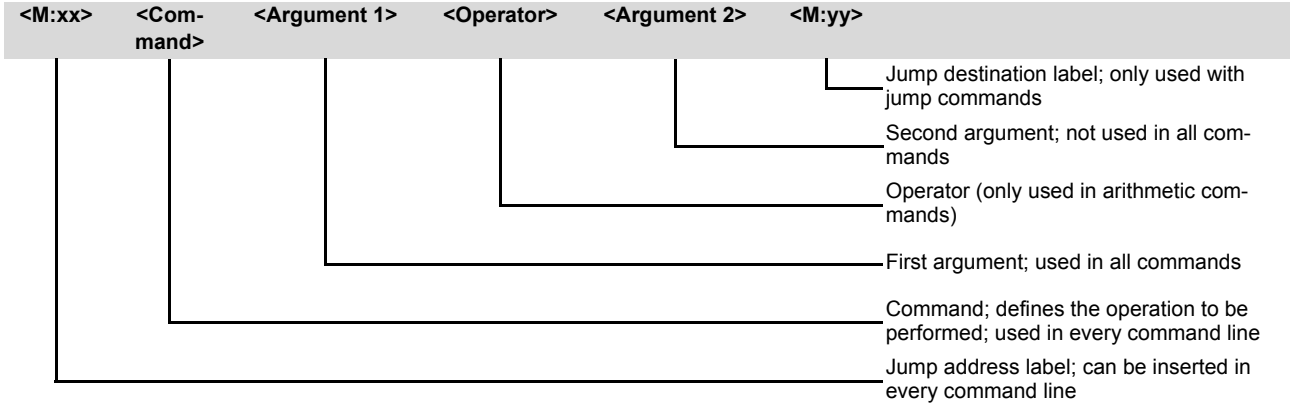
22.1.10 Variables

All variables (H0 - H1023) can be read and written. The variables have a value range from -2^{31} ... $+2^{31}$ - 1. If the variables H0 ... H127 are entered in the variable list or written in the IPOS$^{plus®}$ program with the "MEM" command, they are stored in a non-volatile memory as soon as they are entered. Variables H458 – H511 contain frequently used unit values which are updated cyclically (every 1 ms). These variables are referred to below as system variables and are explained in more detail in section "Overview of System Variables".

	INFORMATION **Be careful when writing system variables!** The effects are described in the section "IPOS$^{plus®}$ with Options".

22.1.11 Program line

Command syntax:



The write command for variables and indices distinguishes between non-volatile and volatile storage. The variables H0 ... H127 can be written and stored using both functions; H128 ... H511 can only be stored in the volatile memory.

Variables H0 ... H127 are always stored in the non-volatile memory via MOVITOOLS® MotionStudio and the keypad. The SET statement of a value for a variable in an IPOS$^{plus®}$ program is always stored in the volatile memory. To store the current status in the non-volatile memory, the command MEM must be performed in the IPOS$^{plus®}$ program.

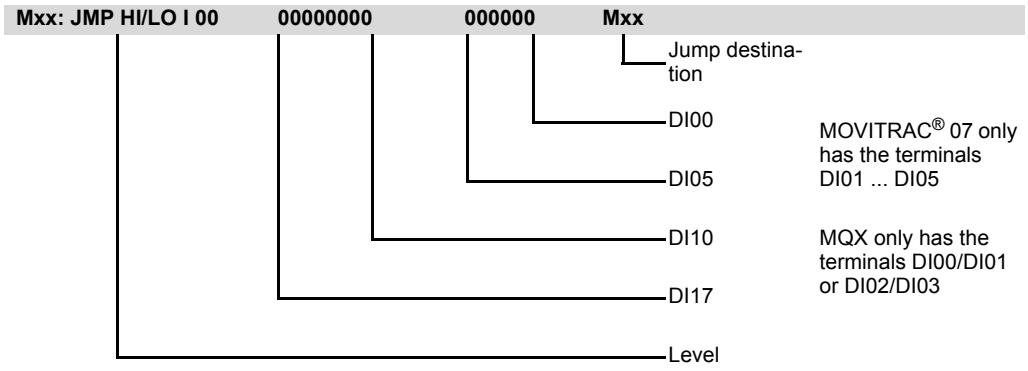
	INFORMATION When using the MEM command note that the variables stored in the non-volatile memory (H0 – 127) and all parameters are not written cyclically. This is because the number of storage operations with the storage medium EEPROM is restricted to 10^5 storage operations.

22.2 Binary inputs/outputs

22.2.1 Binary inputs

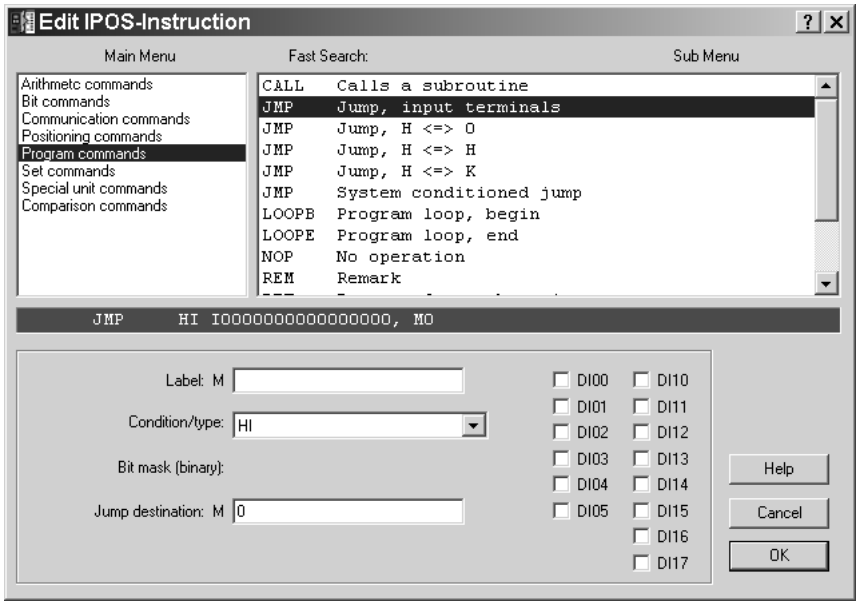
Direct query

The terminal level of binary inputs can be queried in the IPOS$^{plus®}$ program using jump commands. To do so, in the input screen select the terminal level (HI/LO) that should lead to the jump command being performed. Terminals that are to be used for this function must be identified with a "1" in the terminal mask. All defined terminals must have the selected terminal level to fulfill the jump condition for the jump command.



Example

Jump to label 20 if the inputs DI03 and DI04 have a high signal (1), otherwise the next command line is processed:



512410763

Query via system variable

The terminal level of the binary inputs in the basic unit and any installed option are represented cyclically in the system variables **H483 INPUT LVL** (MOVIDRIVE® A) / **H520 INPUT LVL B** (MOVIDRIVE® B). In the process, the bits of the H483 system variable are each assigned to one hardware input.

The assignment of the H483 system variables for MOVIDRIVE® A / H520 for MOVIDRIVE® B to the binary input terminals in described in the section "IPOS$^{plus®}$ Variables / Overview of the system variables".

The binary inputs in the IPOS$^{plus®}$ program can be queried using the value of the variables H483/H520. This is useful for querying inputs to be used to transfer a binary-coded, for example, for selecting a table position.

Table 3: Example of transmitting a binary-coded value via input terminals of MOVIDRIVE® A

Example: Reading inputs	**Unit's binary inputs**					
Terminal designation	DI05	DI04	DI03	DI02	DI01	DI00
Significance	2^5	2^4	2^3	2^2	2^1	2^0
Terminal level	1	0	0	0	1	1
Evaluation	1×2^5	0×2^4	0×2^3	0×2^2	1×2^1	1×2^0
Variable value H483[1)]	32 +	0 +	0 +	0 +	2 +	1 = 35

1) If all DIO11A/DIP11A input terminals and control word 2 are set to level "0".

Binary terminals represented with the higher value bits of variables H483/H520 can also be queried using a combination of the BMOV and JMP commands. This is the case when two options are installed at the same time with terminal expansion.

22.2.2 Binary outputs

Reading binary outputs

The terminal level of the binary inputs in the basic unit and any installed option are represented cyclically in the system variables **H482 OUTPUT LVL** (MOVIDRIVE® A) / **H521 OUTPUT LVL B** (MOVIDRIVE® B). In the process, the bits of the H482 system variable are each assigned to one hardware output.

The individual terminal levels of binary outputs can be evaluated with the BMOV command in the IPOS$^{plus®}$ program. The BMOV command copies a bit from system variable H482 (OUTPUT LVL) / H521 (OUTPUT LVL B) to any bit position (significance) of another variable. The terminal level of output DO02 is queried using the following sample program. To do this, bit 1 of system variable H482 is copied to bit 0 (significance 2^0) of H200. This makes it easy to query (0 or 1) the terminal level with a JMP command.

```
SET     H200 = 0
BMOV H200.0  = H482.1
JMP     H200 == 1 ,Mxx
```

Alternatively, one or more terminal levels of the binary outputs can be filtered using a logical operation with the system variables H 482 (OUTPUT LVL) / H521 (OUTPUT LVL B). The terminal level of output DO02 is queried using the following sample program:

```
M1 :  SET     H200 = 2
AND     H200 & H482
JMP     H200 == 2 ,M1
```

The result of the AND operation is written to the first variable, that is H200. Therefore, the first argument must be a variable.

AND operation of H200 and H482		
H200 = 2	00000000010	(= DO01)
H482 =	11011100110	(= current status of the binary outputs)
Result	00000000010	(= the jump is performed, as H200 = 2)

Setting the binary outputs

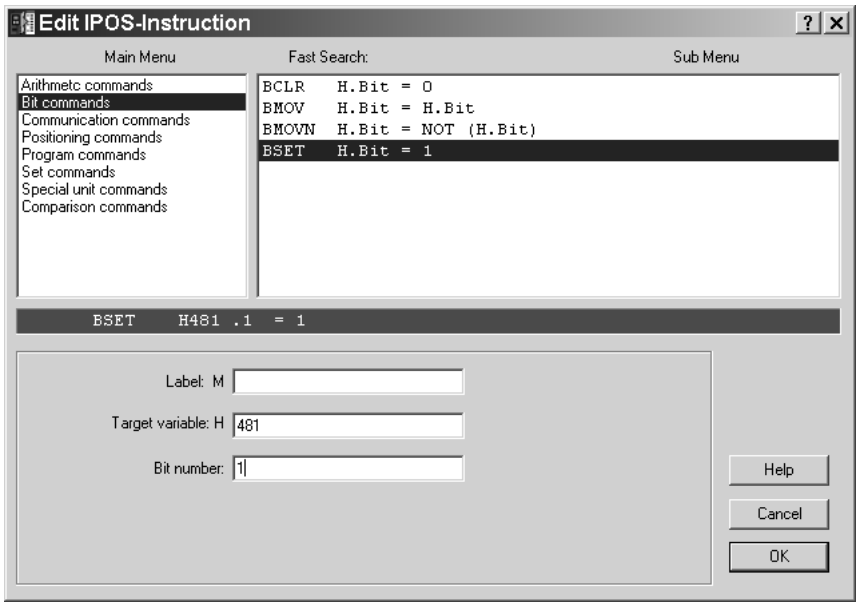
To set the outputs, the binary outputs (parameters 620/621 (MOVIDRIVE® A), 620 ... 626 (MOVIDRIVE® B), 630 ... 637) must be set to "IPOS OUTPUT".

Digital outputs are set using the system variables:

- **H 480 (OPT. OUT IP)** for option DIO11 / DIP11 (DO10 ... DO17)
- **H 481 (STD. OUT IP)** for the basic unit (DO01 / DO02 (MOVIDRIVE® A) DO01 ... DO05 (MOVIDRIVE® B); DB00 is set to "/Brake". The brake is controlled directly by the firmware. As a result, the output cannot be written.)

Setting individual outputs

The **BSET and BCLR commands** are used for setting/resetting individual outputs. To do so, the bit number corresponding to the terminal must be entered as an operand in the command mask. In the following example, output DO01 should be set to "1":



512416139

Overview of commands and parameters for setting/resetting binary outputs:

Table 4: Commands for setting binary outputs

Unit	Output	Setting (1-level)	Resetting (0-level)	Parameter at "IPOS output"
MOVIDRIVE® A MOVIDRIVE® B	DB00	-	-	Set to "/Brake", i.e. cannot be programmed. Controlled by the firmware.
MOVIDRIVE® A MOVIDRIVE® B	DO01	BSET H481.1 = 1	BCLR H481.1 = 0	P620
	DO02	BSET H481.2 = 1	BCLR H481.2 = 0	P621
MOVIDRIVE® B	DO03	BSET H481.3 = 1	BCLR H483.1 = 0	P622
	DO04	BSET H481.4 = 1	BCLR H481.4 = 0	P623
	DO05	BSET H481.5 = 1	BCLR H481.5 = 0	P624
Option	DO10	BSET H480.0 = 1	BCLR H480.0 = 0	P630
	...	...	...	...
	DO17	BSET H480.7 = 1	BCLR H480.7 = 0	P637

Setting several outputs

It is possible to set several binary outputs at the same time, e.g. to output a binary coded table position number. This is done by writing the decimal value of the table position number to system variables H480 or H481.

Table 5: Assigning system variable H480/H481 to binary output terminals

Binary outputs	**Binary outputs DIO11A/DIP11A option H480**								**Binary outputs of basic unit**		
Terminal des.	DO17	DO16	DO15	DO14	DO13	DO12	DO11	DO10	DO02	DO01	DB00
Bits of the system variables	7	6	5	4	3	2	1	0	2	1	0
Significance	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^2	2^1	2^0

Example

Output table position number 11 via DIO11 ("11" requires 3 outputs; that is, outputs DO10, DO11 und DO13):

SET H480 = 11

All binary outputs are reset by setting the system variables H480 and H481 to "0".

This only makes sense if all outputs are set as IPOS$^{plus®}$ outputs. Outputs with other parameter settings are written by the firmware and should not be modified.

SET H480 = 0 Reset the outputs of option DIO11 or DIP11

SET H481 = 0 Reset the outputs of the basic unit

22.3 Analog inputs/outputs

Table 6: Overview of the analog inputs/outputs

Analog inputs/outputs	Inputs						Outputs					
	Basic unit			Option			DIO11 option					
Input/output	AI1			AI2			AO1			AO2		
Terminal designation	AI11	AI12	AGND	AI21	AI22	AGND	AOV1	AOC1	AGND	AOV2	AOC2	AGND

The analog inputs are differential inputs. The inputs/outputs can be used optionally as either voltage or current inputs/outputs.

Table 7: Assigning value ranges to variable values

Input/output	Value range	Variable value
Output	- 10 ... 0 ... + 10 V	- 10 000 ... 0 ... + 10 000
	0 ... + 10 V	0 ... + 10 000
	0 ... + 20 mA	0 ... + 10 000
	4 ... + 20 mA	0 ... + 10 000
Input	- 10 ... 0 ... + 10 V	- 10 000 ... 0 ... + 10 000
	0 ... + 10 V	0 ... + 10 000
	0 ... + 20 mA	0 ... + 5 000
	4 ... + 20 mA	1000 ... + 5 000

Assignment of value range / variable value for analog outputs is only valid if the scaling factor of the parameter P110 is set to 1.

22.3.1 Reading analog inputs/outputs

The status of the analog inputs/outputs of the basic unit and the DIO11 terminal expansion board can be written to variables of your choice using the **GETSYS** command. First enter the variable into the GETSYS command, followed by the system value (here: **ANALOG INPUTS** or **ANALOG OUTPUTS**).

The first input/output is written to the variable entered in the GETSYS command (Hxxx) whilst the second is written to the subsequent variable (Hxxx + 1).

Example

Command **GETSYS H310 = ANALOG INPUTS**

H310 contains the value of the analog input AI1

H311 contains the value of the analog input AI2

22.3.2 Setting analog outputs

INFORMATION

Prerequisite for setting: The corresponding analog output (P640 and P643) must be set to "IPOS OUTPUT".

The analog outputs are set using the **H479 (ANA.OUT IP)** and **H478 (ANA.OUT IP2)** system variables.

Command **SET H479 = K** (K = any constant within the aforementioned value range)

SET H479 describes analog output 1

SET H478 describes analog output 2

23 Assembler – Commands

23.1 General information

- The result of the calculation operation is always assigned to the left-hand argument (always a variable). The second argument (variable or constant) always remains unchanged. The result of a mathematical operation is always a whole number.
- The bit instances in the variables and constants have the numbers 0 ... 31. The least significant bit has the number 0.

23.2 Overview of commands

23.2.1 Arithmetic commands

This program group lists all arithmetic and logical commands.

Command	Key points	Description	see
ADD	H + H H + K	Arithmetical addition	ADD (page 302)
AND	H & H H & K	Logical AND	AND (page 304)
ASHR ARITHMETIC SHIFT RIGHT	H = H (Arithmetic >>) H H = H (Arithmetic >>) K	Arithmetic shift to the right	ASHR (page 306)
DIV DIVISION	H / H H / K	Division	DIV (page 303)
MOD MODULO	H mod H H mod K	Modulo / Division remainder	MOD (page 304)
MUL MULTIPLY	H * H H * K	Multiplication	MUL (page 303)
NOT	H = NOT(H)	Bit-by-bit negation	NOT (page 303)
OR	H ¦ H H ¦ K	Logical OR	OR (page 304)
SHL SHIFT LEFT	H = H << K H = H << H	Bit-by-bit shift to the left	SHL (page 305)
SHR SHIFT RIGHT	H = H >> H H = H >> K	Bit-by-bit shift to the right	SHR (page 306)
SUB SUBTRACT	H - H H - K	Arithmetical subtraction	SUB (page 302)
XOR EXCLUSIVE OR	H XOR H H XOR K	Exclusive OR	XOR (page 305)

23.2.2 Bit commands

Commands for changing individual bits within a variable. These are:

- Setting/clearing/moving bits

Command	Key points	Description	See
BCLR BIT CLEAR	H.Bit = 0	Clear bit	BCLR (page 307)
BMOV BIT MOVE	H.Bit = H.Bit	Copy bit	BMOV (page 307)
BMOVN BIT MOVE NEGATE	H.Bit = NOT (H.Bit)	Copy bit and negate.	BMOVN (page 308)
BSET BIT SET	H.Bit = 1	Set bit	BSET (page 307)

23.2.3 Communication commands

Commands for data exchange from/to other units via interfaces.

Command	Function	Availability[1)]			Reference
		MDX B	MC07B	MQx	
MOVLNK	Acyclic process and/or parameter data exchange via RS-485 or system bus.	X	X	X	MOVLNK (page 309)
MOVCOM	Cyclical process data transfer via RS-485 with MQx for MOVIMOT®.	-	-	X	MOVCOM (page 314)
MOVON	Start of cyclical process data transfer via RS-485.	-	-	X	MOVON (page 315)
SCOM	Cyclical or acyclical process data exchange via system bus.	X	X	-	SCOM (page 316)
SCOMON	Start of cyclical process data exchange via system bus.	X	X	-	SCOMON (page 321)
SCOMST	Start of cyclical transfer for MOVIDRIVE® B.	X	(X)	-	SCOMST (page 322)

1) Observe the unit-specific command structure

23.2.4 Positioning commands

Commands for drive positioning:

- Reference travel
- Absolute/relative/touch probe positioning

Command	Description	See
GO0 GO POSITION 0	Performs reference travel	GO0 (page 323)
GOA GO ABSOLUTE	Absolute positioning, variable Absolute positioning, constant Absolute positioning, variable, indirect	GOA (page 325)
GOR GO RELATIVE	Relative positioning, variable Relative positioning, constant Relative positioning, variable, indirect	GOR (page 325)

23.2.5 Program commands

Commands for program control. These are:

- Loop commands
- Subroutine calls
- Task 2 control
- Program branching commands
- Wait commands

Command	Description	See
CALL	Calls a subroutine	CALL (page 329)
END	Textual end.	END (page 329)
JMP JUMP	Jump, input terminal Jump, H <=> 0. Jump, H <=> H. Jump, H <=> K. System conditioned jump.	JMP (page 330)
LOOPB LOOP BEGIN	Program loop, begin	LOOPB (page 332)
LOOPE LOOP END	Program loop, end	LOOPE (page 332)
NOP NO OPERATION	No operation	NOP (page 333)
REM REMARK	Comments	REM (page 333)
RET RETURN	End of a subroutine	RET (page 333)
TASK2	Sets the start address of task 2	TASK2 (page 334)
WAIT	Waits for a specified period	WAIT (page 335)

23.2.6 Set commands

Commands for:

- Setting variables
- Error responses
- Loading system values to variables
- Writing system values to system variables
- Initializing interrupt routines

Command	Description/arguments	See
COPY	Block-by-block copying of variables	COPY (page 336)
GETSYS GET SYSTEM VALUE	H = System value	GETSYS (page 336)
SET	H = H H = K	SET (page 339)
SETFR SET FAULT REACTION	Set fault response	SETFR (page 339)
SETI SET INDIRECT	[H] = H H = [H]	SETI (page 339)
SETINT SET INTERRUPT	Sets start address of the interrupt routine	SETINT (page 339)
SETSYS SET SYSTEM VALUE	System value = H	SETSYS (page 344)
VARINT	Sets start address and data structure for variable interrupt	VARINT (page 347)

23.2.7 Special unit commands

Commands for:

- Stopping the axis
- Storing variables and programs in non-volatile memory in the unit
- Switching touch probe on/off
- Controlling the watchdog

Command	Description	See
ASTOP AXIS STOP	Stops axis	ASTOP (page 349)
MEM MEMORIZE	Saves and loads IPOS$^{plus®}$ program and variables.	MEM (page 349)
TOUCHP TOUCH PROBE	Touch probe command	TOUCHP (page 350)
WDOFF WATCHDOG OFF	Switches off the watchdog	WDOFF (page 353)
WDON WATCHDOG ON	Calls the watchdog in time intervals	WDON (page 353)

23.2.8 Comparison commands

Commands for comparing variables and constants.

Command	Key points	See
ANDL LOGICAL AND	H = H && H	ANDL (page 358)
CPEQ COMPARE EQUAL	H = H == H H = H == K	CPEQ (page 355)
CPGE COMPARE GREATER OR EQUAL	H = H >= K H = H >= H	CPGE (page 355)
CPGT COMPARE GREATER THAN	H = H > H H = H > K	CPGT (page 356)
CPLE COMPARE LESS OR EQUAL	H = H <= H H = H <= K	CPLE (page 356)
CPLT COMPARE LESS THAN	H = H < H H = H < K	CPLT (page 357)
CPNE COMPARE NOT EQUAL	H = H != H H = H != K	CPNE (page 357)
NOTL LOGICAL NOT	H = NOT(H)	NOTL (page 359)
ORL LOGICAL OR	H = H ¦¦ H	ORL (page 358)

23.3 Arithmetic commands

23.3.1 Fundamental operations ADD / SUB / MUL / DIV

The four basic arithmetical functions are performed taking account of signs. They can also be performed with variables H and constants K. The 1st argument is always a variable H, the 2nd argument can either be a second variable H or a constant K.

ADD

The ADD command adds a variable to a constant and a variable (observing the signs).

Command structure Mxxx ADD X1 + X2	Mxxx: Label (optional) X1: Variable (summand and sum) X2: Variable or constant (summand)
ADD HXX + HYY	Variable HXX is the sum of variables HXX and HYY.
ADD HXX + K	Variable HXX is the sum of variables HXX and a constant K.
Example 1	`SET H01 = 100ADD H01 + H01` After the ADD command, H01 = 200.
Example 2	`SET H01 = 100ADD H01 + 1` After the ADD command, H01 = 101.

Example 3	`SET H01 = 2000000000SET H02 = 2000000000ADD H01 + H02`
	`[0x77359400][0x77359400][0xEE6B2800]`
	The number range has been exceeded.
	After addition, H01 has the value -294967296.

Note	If the number range is exceeded during addition, the result is incorrect. There is no error message.

SUB/SUBTRACT

The SUB command subtracts a variable or constant from a variable (observing the signs).

Command structure Mxxx SUB X1 - X2	Mxxx: Label (optional) X1: Variable (minuend and difference) X2: Variable or constant (subtrahend)
SUB HXX - HYY	Variable HXX is the result of the subtraction of variables HXX and HYY.
SUB HXX - K	Variable HXX is the result of the subtraction of variables HXX and a constant K.
Example 1	`SET H01 = -10SET H02 = +50SUB H01 - H02` After the SUB command, H01 = -60.

Example 2	`SET H01 = +50SET H02 = -2147483600SUB H01 - H02`
	`[0x00000032][0x80000030][0x80000002]`
	The number range has been exceeded. After subtraction, H01 has the value -2147483646.

Note	If the number range is exceeded during subtraction, the result is incorrect. There is no error message.

MUL/MULTIPLY

The MUL command multiplies a variable with a constant or a variable (observing the signs).

Command structure Mxxx MUL X1 * X2	Mxxx: Label (optional) X1: Variable (factor and product) X2: Variable or constant (factor)
MUL HXX * HYY	Variable HXX is the result of the multiplication of variables HXX and HYY.
MUL HXX * K	Variable HXX is the result of the multiplication of variable HXX and a constant K.
Example 1	`SET H01 = -3MUL H01 * 50` After the MUL command, H01 = -150.
Example 2	`SET H01 = +50000SET H02 = +50000MUL H01 * H02 [0x0000C350][0x0000C350][0x9502F900]` The number range has been exceeded. After multiplication, H01 has the value -1794967296.
Note	If the number range is exceeded during multiplication, the result is incorrect. There is no error message.

DIV/DIVISION

The DIV command divides a variable by a variable or a constant (observing the signs). The result is the predecimal number of the quotient.

Command structure Mxxx DIV X1/X2	Mxxx: Label (optional) X1: Variable (dividend and quotient) X2: Variable or constant (divisor)
DIV HXX/HYY	Variable HXX is the result of the division of variables HXX and HYY.
DIV HXX/K	Variable HXX is the result of the division of variables HXX and a constant K.
Example	`SET H01 = -13SET H02 = +3DIV H01/H02` After the DIV command, H01 = -4.
Note	Division by zero leads to an undefined result. There is no error message.

23.3.2 Auxiliary arithmetic functions NOT/MOD

NOT

The command negates the entire content of a variable bit-by-bit.

Command structure Mxxx NOT X1 = NOT (X2)	Mxxx: Label (optional) X1: Variable (Result of the operation) X2: Variable (output value)
NOT HXX = NOT (HYY)	Variable HXX negates the variable HYY bit-by-bit. In this way, the hexadecimal sum of HXX and HYY = 0xFFFFFFFF.
Example	`SET H02 = +1NOT H01 = NOT (H02) [0x00000001][0xFFFFFFFE]` After the NOT command, H01 = -2.

MOD/MODULO

The command supplies the integer remainder when a variable has been divided by a variable or a constant. The sign of the result is the same as the sign of the first variable.

Command structure Mxxx MOD X1 mod X2	Mxxx: Label (optional) X1: Variable (dividend and remainder of division) X2: Variable or constant (divisor)
MOD HXX mod HYY	Variable HXX is the integer remainder after division of variables HXX and HYY.
MOD HXX mod K	Variable HXX is the integer remainder after division of variable HXX and a constant K.
Example 1	`SET H01 = -17SET H02 = -5MOD H01 mod H02` `SET H01 = -17SET H02 = +5MOD H01 mod H02` After the MOD command, H01 = -2.
Example 2	`SET H01 = +17SET H02 = +5MOD H01 mod H02` `SET H01 = +17SET H02 = -5MOD H01 mod H02` After the MOD command, H01 = +2.

23.3.3 Logical operations AND/OR/XOR

AND

The AND command performs a bit-by-bit AND operation between a variable and a second variable or a hexadecimal constant.

Command structure Mxxx AND X1 & X2	Mxxx: Label (optional) X1: Variable (result and output value) X2: Variable or constant (output value)
AND HXX & HYY	Variable HXX is the bit-by-bit AND operation of variables HXX and HYY.
AND HXX & K	Variable HXX is the bit-by-bit AND operation of variable HXX and a constant K.
Example 1	`SET H01 = 12SET H02 = 5AND H01 & H02` `[0b0000000000001100][0b0000000000000101][0b0000000000000100]` After the AND command, H01 = 4.
Example 2	The position within a motor revolution is to be determined from the position of the motor encoder. `SET H01 = H511AND H01 & 0xFFF` After the AND command, H01 has a value between 0 and 4095.

OR

The OR command performs a bit-by-bit OR operation between a variable and a second variable or a hexadecimal constant.

Command structure Mxxx OR X1 ¦ X2	Mxxx: Label (optional) X1: Variable (result and output value) X2: Variable or constant (output value)
OR HXX ¦ HYY	Variable HXX is the bit-by-bit OR operation of variables HXX and HYY.
OR HXX ¦ K	Variable HXX is the bit-by-bit OR operation of variable HXX and a constant K.
Example	`SET H01 = 12SET H02 = 1OR H01 ¦ H02` `[0b0000000000001100][0b0000000000000001][0b0000000000001101]` After the OR command, H01 = 13.

XOR

The XOR command performs a bit-by-bit XOR operation between a variable and a second variable or a hexadecimal constant.

Command structure Mxxx XOR X1 XOR X2	Mxxx: Label (optional) X1: Variable (result and output value) X2: Variable or constant (output value)
XOR HXX XOR HYY	Variable HXX is the bit-by-bit XOR operation of variables HXX and HYY.
XOR HXX XOR K	Variable HXX is the bit-by-bit XOR operation of variable HXX and a constant K.
Example	`SET H01 = 65535XOR H01 XOR F0F0 hex` `[0x00000FFF][0x0000FF0F]` After the XOR command, H01 = 0xFF0F.

23.3.4 SHIFT commands SHL/SHR/ASHR

SHIFT commands are used to move the content of a variable bit-by-bit. All variable bits are given a new significance. The number of places to be shifted is specified in the 2nd argument.

SHL/SHIFT LEFT

The SHL command moves the content of a variable to the left by the number of bits specified in a variable or constant. Zeros are moved along from the right.

Command structure Mxxx SHL X1 << X2	Mxxx: Label (optional) X1: Variable (result and output value) X2: Variable or constant (number of shift operations)
SHL HXX << HYY	In variable HXX the bits are shifted HYY places to the left.
SHL HXX << K	In variable HXX the bits are shifted by K places to the left.
Example 1	`SET H01 = 31SET H02 = 1SHL H01 << H02` `[0b0000000000011111][0b0000000000111110]` After the SHL command, H01 = 62.
Example 2	A certain binary significance is assigned to the output terminals of the basic unit and the DIO11A option. To use outputs DO10 ... DO13 for table positioning in a useful manner (4 entries = 0 ... 15 positions), shift the significance of the outputs so that the terminal with the lowest value DO10 receives the significance 2^0. `SET H01 = 15SET H02 = 6SHL H01 << H02` `[0b0000000000001111][0b0000001111000000]`

SHR/SHIFT RIGHT

The SHR command moves the content of a variable to the right by the number of bits specified in a variable or constant. Zeros are moved along from the left.

Command structure Mxxx SHR X1 >> X2	Mxxx: Label (optional) X1: Variable (result and output value) X2: Variable or constant (number of shift operations)
SHR HXX >> HYY	In variable HXX the bits are shifted HYY places to the right.
SHR HXX >> K	In variable HXX the bits are shifted K places to the right.
Example 1	`SET H01 = 62SET H02 = 1SHR H01 > > H02` `[0b0000000000111110][0b0000000000011111]` After the SHR command, H01 = 31.
Example 2	A certain binary significance is assigned to the input terminals of the basic unit and the DIO11A option. To use inputs DI10 ... DI13 for table positioning in a useful manner (4 entries = 0 ... 15 positions), shift the significance of the inputs so that the terminal with the lowest value DI10 receives the significance 2^0. `SET H01 = 960SET H02 = 6SHR H01 > > H02` `[0b0000001111000000][0b0000000001111]`

ASHR/ARITHMETIC SHIFT RIGHT

The ASHR command shifts the content of a variable to the right by the number of bits specified in a variable or constant. Either zeros or ones are shifted along from the left, depending on the sign of the original value. This ensures that a negative sign is kept during shift operations.

For positive numbers, the command supplies the predecimal number of the division X1/X2. For negative numbers, the command supplies the predecimal number of the division X1/X2 - 1.

Command structure Mxxx ASHR X1 >> X2	Mxxx: Label (optional) X1: Variable (result and output value) X2: Variable or constant (number of shift operations)
ASHR HXX >> HYY	In variable HXX the bits are shifted HYY places to the right.
ASHR HXX >> K	In variable HXX the bits are shifted K places to the right.
Example 1	`SET H01 = 7ASHR H01 > > 2` `[0b0000000000000111][0b0000000000000001]` After the SHR command, H01 = 1.
Example 2	`SET H01 = -7ASHR H01 > > 2` `[0b1111111111111001][0b1111111111111110]` After the ASHR command, H01 = -2.

23.4 Bit commands

23.4.1 Bit commands BSET/BCLR/BMOV/BMOVN

BSET/BIT SET

The BSET command sets a bit within a variable to 1. The bit places in the variable have the numbers 0 ... 31. The least significant bit has the number 0.

For example, if a bit is set in the system variable H481 STD.OUT IP, a binary output can be set directly. You must set the output to IPOS OUTPUT in parameters P62x in SHELL beforehand.

Command structure Mxxx BSET HX1.X2 = 1	Mxxx: Label (optional) X1: Target variable X2: Bit position in a target variable
BSET HXX.YY = 1	In variable HXX, bit YY is set to 1.
Example	SHELL: P621 = IPOS OUTPUT `BSET H481.2 = 1` After the BSET command has been performed, the 3rd bit is set in variable H481 and output DO02.
Note	If the output is reserved for a different function (for example, P621 = MOTOR STANDSTILL), the bit is set in H481, but not the binary output.

BCLR/BIT CLEAR

The BCLEAR command sets a bit within a variable to 0. The bit places in the variable have the numbers 0 ... 31. The least significant bit has the number 0.

For example, if a bit is cleared in the system variable H481 STD.OUT IP, it resets a binary output directly. You must set the output to IPOS OUTPUT in parameters P62x in SHELL beforehand.

Command structure Mxxx BCLEAR HX1.X2 = 1	Mxxx: Label (optional) X1: Target variable X2: Bit position in a target variable
BCLEAR HXX.YY = 0	In variable HXX, bit YY is set to 0.
Example	SHELL: P621 = IPOS OUTPUT `BCLEAR H481.2 = 0` After the BCLEAR command has been performed, the 3rd bit is cleared in variable H481 and output DO02.
Note	If the output is reserved for a different function (for example, P621 = MOTOR STANDSTILL), the bit is cleared in H481, but not the binary output.

BMOV/BIT MOVE

The BMOV command copies a bit from one variable in a bit in another variable. The bit places of a variable have the numbers 0 ... 31. The least significant bit has the number 0.

Command structure Mxxx BMOV HX1.X2 = HX3.X4	Mxxx: Label (optional) X1: Target variable X2: Bit position in a target variable X3: Source variable X4: Bit position in a source variable
BMOV HXX.YY = HZZ.AA	In variable HXX, the bit YY is set to the value of bit AA of the variable HZZ.
Example 1	`BMOV H2.4 = H7.5` The command copies bit 5 of variable H7 into bit 4 of variable H2.
Example 2	`SET H200 = 0BMOV H200.0 = H473.20JMP H200 == 1 M01` The program jumps to the label M01 when the drive is referenced (H473 STAT. WORD).

BMOVN/BIT MOVE NEGATE

The BMOVN command copies a bit from one variable to a bit in another variable, negating it in the process. The bit places of a variable have the numbers 0 ... 31. The least significant bit has the number 0.

Command structure Mxxx BMOVN HX1.X2 = HX3.X4	Mxxx: Label (optional) X1: Target variable X2: Bit position in a target variable X3: Source variable X4: Bit position in a source variable
BMOVN HXX.YY = HZZ.AA	In variable HXX, the bit YY is set to the negated value of bit AA of the variable HZZ.
Example 1	`BMOVN H2.4 = H7.5` The command copies the negated bit 5 of variable H7 into bit 4 of variable H2.
Example 1	`SET H200 = 0BMOV H200.0 = H473.20JMP H200 == 1 M01` The program jumps to the label M01 when reference travel has not yet been performed for the drive (H473 STAT. WORD).

23.5 Communication commands

23.5.1 MOVLNK

Description, see _MoviLink (page 222)

Command structure

Instruction type	Standard structure	Elements	Brief description
_MoviLink	MOVLNK	BusType (H+0)	Possible bus types: ML_BT_S0 = 1 (RS485 #1) ML_BT_S1 = 2 (RS485 #2) ML_BT_SBUS1 = ML_BT_SBUS = 5 ML_BT_SBUS2 = 8
		Address (H+1)	0...99: Single address 100...199: Group address 253: Address of the inverter 254: Point-to-point connection 255: Broadcast If an SBus group address (e.g. 43) is addressed, the offset 100 must be added. In this case 143.

		Format (H+2)	Specification of the process (PD) and parameter (PARAM) channels for data transfer:
			//MoviLink Cyclic Frame Types — //Acyclic
			ML_FT_PAR1 = 0: PARAM+1PD — ML_CFT_PAR1 = 128
			ML_FT_1 = 1: 1PD — ML_CFT_1 = 129
			ML_FT_PAR2 = 2: PARAM+2PD — ML_CFT_PAR2 = 130
			ML_FT_2 = 3: 2PD — ML_CFT_2 = 131
			ML_FT_PAR3 = 4: PARAM+3PD — ML_CFT_PAR3 = 132
			ML_FT_3 = 5: 3PD — ML_CFT_3 = 133
			ML_FT_PAR = 6: Parameter (without PD) — ML_CFT_PAR = 134

		Service (H+3)	Communication service for parameters ML_S_RD = 1: Read service ML_S_WR = 2: Write to non-volatile memory ML_S_WRV = 3: Writing without saving
		Index (H+4)	Index number of the parameter to be modified or read (see parameter index directory) The subindex must be entered in the index element on bits 23-16 (least significant byte of the high word). Calculation: H+4 or `MOVILNK.Index = Index + (SubIndex << 16);`
		DPointer (H+5)	Number of the variable from which the read data is stored or from which the data to be written is obtained (structure MLDATA)
		Result (H+6)	Contains the error code after the service has been performed or contains zero if there was no error (see "Parameterization Return Codes" in the "Communication and Fieldbus Unit Profile" manual with "parameter list").
	MLDATA	WritePar (H"+0)	Parameter that is sent for write services
		ReadPar (H"+1)	Parameter that is sent for read services
		PO1 (H"+2)	Process output data 1
		PO2 (H"+3)	Process output data 2
		PO3 (H"+4)	Process output data 3
		PI1 (H"+5)	Process input data 1
		PI2 (H"+6)	Process input data 2
		PI3 (H"+7)	Process input data 3

The following table shows the elements with unit-specific characteristics.

Element	Unit-specific characteristics		
	MOVIDRIVE® B	**MOVITRAC® B**	**MQx**
BusType (H+0)	only 2: (RS485 at X13) 5: (SBUS at X12) 8: (via DFC11B)	only 2: (RS485 at FSC/FIO11B) 5: (SBUS at FSC/FIO21B)	only 2: (RS485 to MOVIMOT®)
Format (H+2)	no limitation	no limitation	only 130: (Param + 2PD acyclical) 131: (2PD acyclical) 132: (Param + 3PD acyclical) 133: (3PD acyclical) 134: (Param acyclical) Cyclical frame types are possible but _MovCommDef is recommended.

Structure

Command structure Mxxx MOVLNK X1	Mxxx: Label (optional) X1: Starting variable of the command structure
MOVLNK HXX	The MOVLNK command is performed using the command structure data starting in variable HXX.

Parameter settings for the sender (master)

Description, see Parameter settings for the sender (master) (page 225)

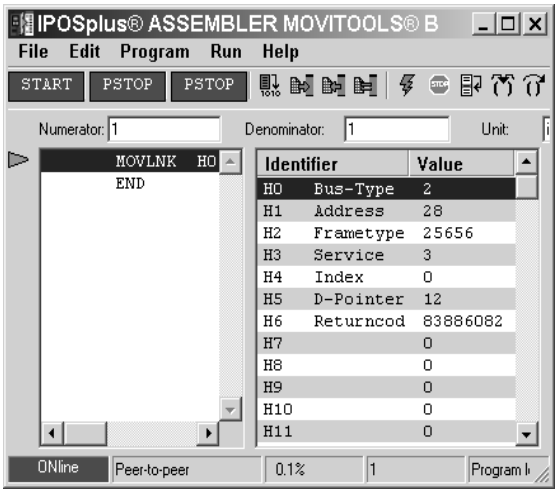
Parameter settings for the receiver

Description, see Parameter settings for the receiver (page 226)

Example 1

Reading an "internal" unit parameter (analog input AI1)

The following IPOS$^{plus®}$ program and parameter setting are used to read the display parameter P020 with the index number 8331 and then to write it to variable H011. The variable structure has been entered here in the editing window for variables The variable structure can also be created in the program using SET commands.



514449547

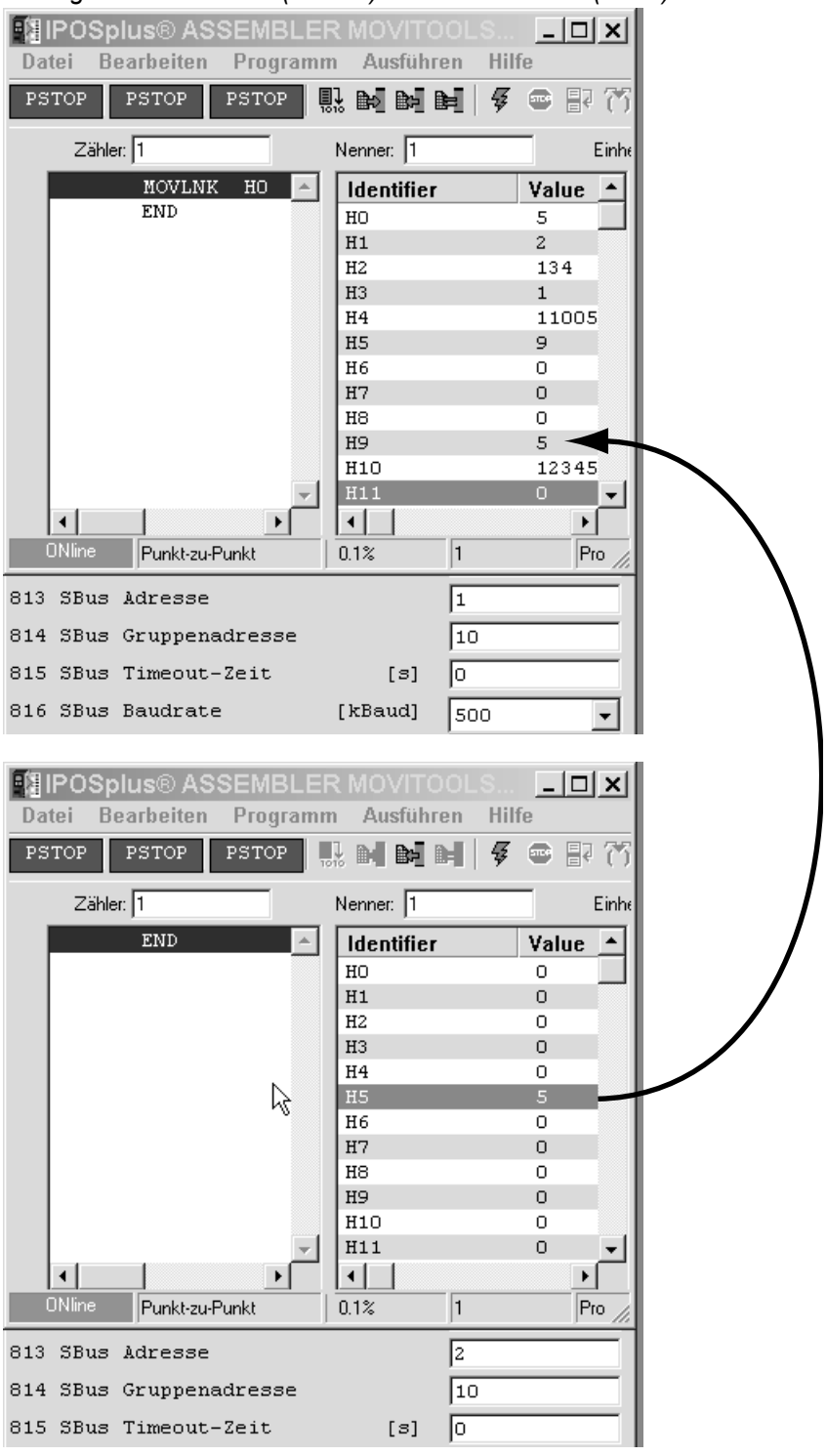
H0 Bus-Type	5	= SBus (not relevant)
H1 Address	253	= own address
H2 Frametype	134	= only Para
H3 Service	1	= Read
H4 Index	8331	= Index of P020
H5 D-Pointer	10	= Data pointer value at H10

Example 2

Axis-to-axis communication: Reading variables from another inverter via SBus

The value of variable H005 on the receiver axis is read and written to variable H010 in the sender. To do this, it is necessary to have 2 inverters connected via the SBus and for the terminating resistors to be activated (using DIP switch S12).

Settings above: Sender (Master) / below: Receiver (slave)



514453899

H0 Bus-Type	5	= SBus
H1 Address	2	= SBus address of receiver (slave)
H2 Frametype	134	= only Para
H3 Service	1	= Read
H4 Index	11005	= Index of H5
H5 D-Pointer	9	= Data pointer value at H9

Example 3

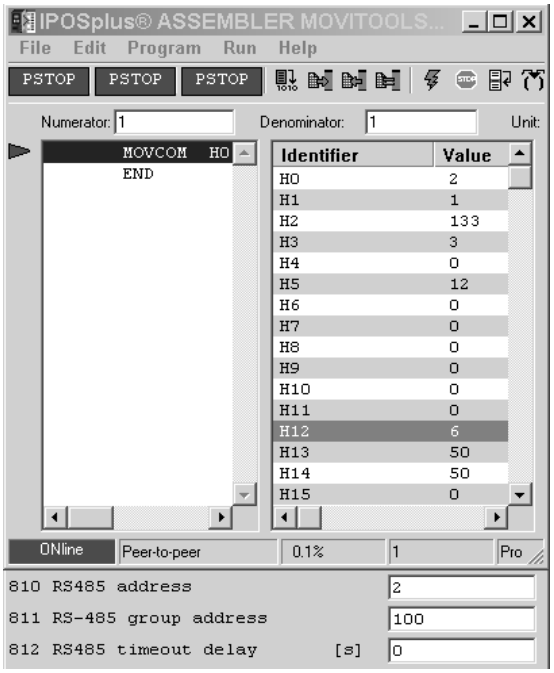
Controlling a MOVIMOT® unit via RS-485 and 3PD

MOVIMOT® must be started up in accordance with the MOVIMOT® operating instructions.

Communication with MOVIMOT® is only possible via RS-485. Control is only possible via the process data channel with 2PD or 3PD (min. control word and speed).

In the following example, MOVIMOT® is controlled using 3 process output data items (control word 1, speed and ramp).

The values should be entered in variables H012 ... H014.



514510219

H0 Bus-Type	2	= RS-485
H1 Address	1	= RS-485 address of the receiver (MOVIMOT®)
H2 Frametype	133	= 3PD
H3 Service	3	= Writing without saving
H4 Index	0	= not relevant for PD
H5 D-Pointer	12	= Data pointer value at H12
H12	6	= PO1 Control word
H13	50	= PO2 speed in percent
H14	50	= PO3 ramp in percent

	INFORMATION With MOVIDRIVE® B and MOVITRAC® B, the timeout monitoring is checked for telegrams received within the defined timeout interval. With MOVIMOT®, the timeout monitoring is activated with the first received cyclic frames (ML_FT... at the sender). Acyclical communication deactivates the timeout monitoring of MOVIMOT®. Once cyclical communication has been started with the _MovCommOn command, only the _MoviLink command to address 253 (internal) is possible. When using the _MoviLink command, other units can no longer be accessed.

23.5.2 MOVCOM

The command can be used with MQx only. The MovComm commands enable cyclical data exchange between MQx and up to 8 MOVIMOT® units via the RS-485 interface with the MOVILINK profile.

For a detailed description, refer to _MovCommDef (page 227).

The variable is defined by the **MOVCOM variable name;** in the Compiler and has the following structure.

BusType (H+0)	**Bus type (interface)** ML_BT_S1 = 2 (RS485 to MOVIMOT®)
Address (H+1)	**Individual address or group address for the MOVIMOT®to be addressed** 0 ... 99 single addressing 100 ... 199 group addressing 255 broadcast
Format (H+2)	**Entry of process data for data transfer** 3 = 2 process data words cyclically (for MOVIMOT®) = ML_FT_2 5 = 3 process data words cyclically (for MOVIMOT®) = ML_FT_3
Pd Pointer (H+3)	**Number of the variable H" in which the process data is stored or from which the data to be written is obtained**. (The data structure for H" is described in detail below.)
Para Pointer (H+4)	**Number of the variable H' in which the parameter data is stored or from which the data to be written is obtained**. MOVIMOT® does not support this function.

Variable structure of the process data

Data structure for H":	
H"+0	Contains the error code after connection, or zero if there was no error 0x05000002 indicates the connection has timed out.
H"+1	PO1 data of process data exchange
H"+2	PI1 data of process data exchange
H"+3	PO2 data of process data exchange
H"+4	PI2 data of process data exchange
H"+5	PO3 data of process data exchange
H"+6	PI3 data of process data exchange

The process data is coded according to MOVILINK.

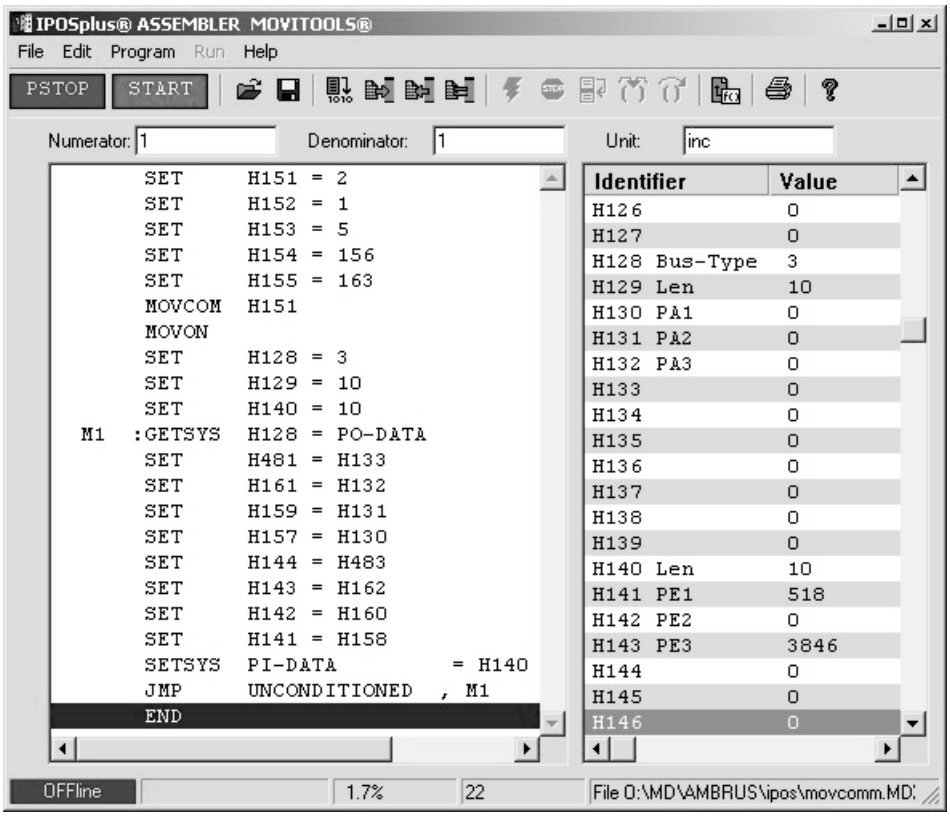
Variable structure of the parameter data

H*+0	Contains the error code after the parameter service has been performed, or contains zero if there was no error The errors are coded according to MOVILINK.
H*+1	0: No action or parameter data exchange is complete. 1: Start of the parameter data exchange
H*+2	1: Read service 2: Write with storage in non-volatile memory 3: Writing without saving
H*+3	Index number of parameter to be revised or read
H*+4	Read data after read service. Data to be written in case of a write service.

Proceed as follows when making parameter settings:

1. Entry of service, index and data
2. Start the parameter setting process by setting StartPar to 1.
3. Wait for the service to be performed; end is indicated when StartPar is set to 0.
4. Evaluate ParaResult. If an error has occurred, the data value is invalid. If no error occurred, the service was successful.

Sample program



514515083

23.5.3 MOVON

The command cannot be used with MOVIDRIVE®.

The command starts the cyclical communication. Communication links set up using the MovCommDef command are activated. As of this point, you can no longer use MovCommDef or MOVILINK commands. Only the MOVILINK command to address 253 (internal) can still be used.

23.5.4 SCOM

An SCOM command (**System bus COM**munication) can be used to transfer up to 2 variables (8 bytes) via the system bus. The SCOM command initializes the transfer object and defines whether the object should be sent acyclically or cyclically or whether objects are to be received. In the latter two cases, the transfer must also be started with SCOMON or SCOMSTATE.

Data exchange is only possible via the system bus and it transfers all the content of the variables. Data exchange within the inverter is not possible. A standard CAN telegram (11 bit identifier) is used instead of a SEW's own protocol (MOVILINK) so that the system can also communication with non-SEW products (see the "MOVIDRIVE® Serial Communication" manual).

In accordance with the consumer/producer principle, every unit can send objects to one or more units and receive objects from one or more units simultaneously.

The bus run time for a message is ≤ 2 ms and depends on the baudrate setting. Communication with MOVIMOT® or the MQ fieldbus interface is not possible.

Structure

Command structure Mxxx SCOM X1, X2	Mxxx: Label (optional) X1: TRANSMIT CYCLIC: Cyclical send RECEIVE: Receive TRANSMIT ACYCLIC: Acyclical send X2 Hxx = Start of object structure for communication and user data

The design of the object structure is dependent on the first argument X1.

Example

```
SCOM TRANSMIT CYCLIC, H0
```

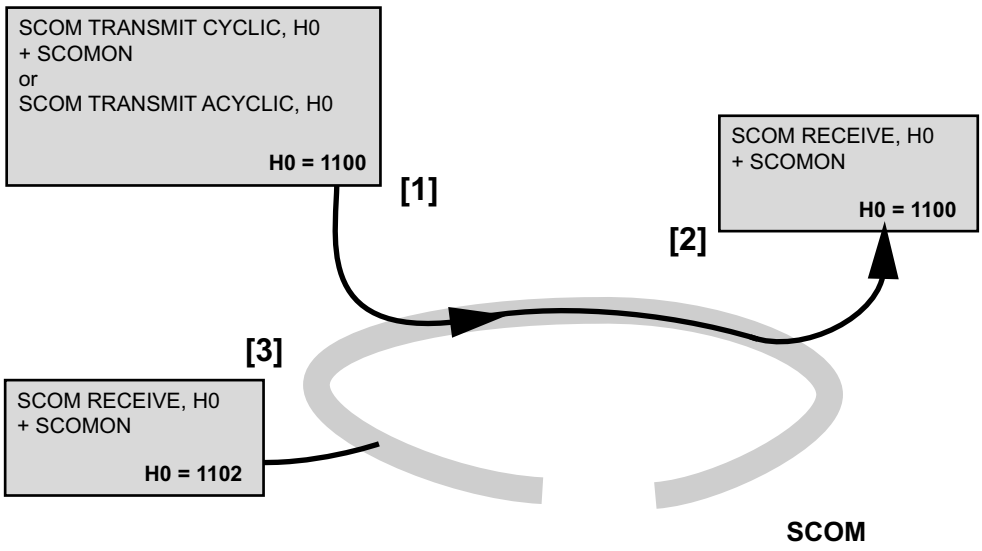
This command initializes cyclical transfer; the object structure starts at H0.

```
SCOM TRANSMIT ACYCLIC, H10
```

This command initializes a one-off cyclical transfer; the object structure starts at H10.

```
SCOM RECEIVE, H50
```

The command initializes the reception of data, the object structure starts at H50.



514545547

Unit [1] sends the object with the no. 1100 cyclically or acyclically.

Unit [2] receives the data. Unit [3] ignores data but is waiting for data with object number 1102.

Sender and receiver settings

Sender	Receiver
IPOS$^{plus®}$ program with command: – SCOM TRANSMIT CYCLIC H SCOMON *and/or* – SCOM TRANSMIT ACYCLIC H • Setting of communication parameters via variables	IPOS$^{plus®}$ program with command: – SCOM RECEIVE H SCOMON • Setting of communication parameters via variables • Timeout monitoring P817
SBus baud rate (P816/P884/P894) identical for sender and receiver.	
First and last physical stations: Set the bus terminating resistor via S12.	

INFORMATION

Observe the following rules when selecting the object number:

1. In the entire SBus network, an object number can only be set up for transmission once.
2. Within a unit, an object number may only be set up once, either once for sending or once for receiving.

See also _SbusCommDef (page 227)

TRANSMIT CYCLIC:

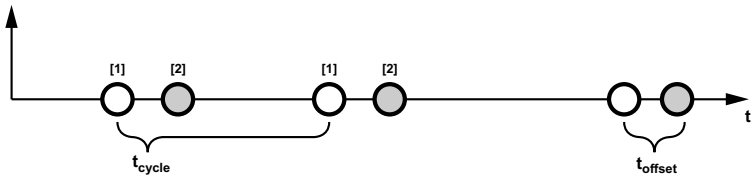
This argument initializes a data object whose user data is sent cyclically according to the SCOMON command. Variable H of the SCOM TRANSMIT CYCLIC H command defines the start of the communication and user data.

Cyclical data exchange runs in the background once it has been started, regardless of the current command processing in the IPOS$^{plus®}$ program. If the program is stopped, the data transfer stops automatically. A change of the data object will only become active following an IPOS$^{plus®}$ program restart (F5 A/P-STOP / F9 P-Start, or mains (24V auxiliary operation) turned off and then on again)

Pro SCOM TRANSMIT... command can set up one data object at the most. Additional SCOM TRANSMIT commands must be sent if additional data objects are to be set up. Only one SCOMON command is required following several SCOM TRANSMIT commands. After the first SCOMON command, no other SCOM TRANSMIT commands are accepted.

The number of objects that can be set up depends on the cycle time (max. 5 objects at 1 – 9 ms, max. 10 objects at 10 – 65530 ms, i.e. 15 objects in total).

Object structure

H+0	**Object number (CAN-Bus-ID):** The object number is used for addressing the data object. The object numbers of the sender (TRANSMIT) and receiver (RECEIVE) must be the same for the data exchange.
H+1	**Cycle time** in ms: Specifies the time interval after which the data is sent again. Valid cycle times: See _SbusCommDef (page 227) Note: The value 0 ms causes an error message to be issued in the return code. The cycle time must always exceed the longest offset time.
H+2	**Offset** in ms distributes the bus load when several SCOM TRANSMIT... commands are used.  514549899 Valid offset times: See _SbusCommDef (page 227)
H+3	**Number of data bytes and data format**

Bit	Value	Function
0...3	0...8	Number of data bytes
4...7	0	Reserved
8	0...1	0 = MOTOROLA format 1 = INTEL format **The format of the sender and receiver must be the same!**
9...31	0	Reserved

H+4	**Number of variable H" at which the data to be sent are to start.**
H+5	**Result (Return Code) of SCOM command** ≥0 Free bus capacity in % (calculated value of this unit) -1 Incorrect cycle time -2 Too many objects set up -3 Bus overload -5 Wrong object number -6 Wrong length
	Ensure that the entire calculated bus utilization does not exceed 70% for additional data exchange between slaves. The bus utilization is calculated in bits per second using the formula: Number of telegrams × bits/telegram × 1/cycle time For example, 2 messages with 100 bits in 1 ms cycle = 200000 bits/s = 200 kBaud This results in the following bus load percentage in reference to the selected baud rate. For example, 200 kBaud / 500 kBaud = 40% < 70%

TRANSMIT ACYCLIC

This argument initializes a data object, whose user data is transmitted once immediately. Variable H of the **SCOM TRANSMIT ACYCLIC H** command defines the start of the communication and user data. A SCOMON command is not required.

A SCOM TRANSMIT ACYCLIC H command is used to send several variables. To do so, set the variable pointer (H+2) accordingly in the IPOS$^{plus®}$ program before calling each command.

Object structure

H+0	**Object number (CAN-Bus-ID):** The object number is used for addressing the data object. An object number can only be allocated once in a bus system. The object numbers of the sender (TRANSMIT) and receiver (RECEIVE) must be the same for the data exchange. The object numbers > 1024 ... 2048 should be used to avoid a data clash whenever MOVLNK commands are also used via the SBus.
H+1	**Number of data bytes and data format**

Bit	Value	Function
0...3	0...8	Number of data bytes
4...7	0	Reserved
8	0...1	0 = MOTOROLA format 1 = INTEL format **The format of the sender and receiver must be the same!**
9...31	0	Reserved

H+2	Number of variable H" at which the data to be sent are to start.	
H+3	Status of the transmission command	
	0	Ready
	1	Sending
	2	Sending successful
	10	Send error

INFORMATION

Prior to transmitting acyclical telegrams, the SBus must also be activated with SCOMON and SCOMSTATE.

The IPOS$^{plus®}$ program waits at this command until the message has been sent. If no other station is connected the telegram cannot be sent. The wait status can only be ended by a monitoring function, for example, from another task.

RECEIVE

This argument initializes a data object that contains data received cyclically or acyclically. The variable in the argument of the SCOM RECEIVE command contains the variable number as of which the receive data is to be stored.

The process of reading in the data must be started with the SCOMON command. The process of reading in data runs in the background once it has been started, regardless of the current command processing in the IPOS$^{plus®}$ program. After the first SCOMON command, no other SCOM RECEIVE commands are accepted. A change of the data object will only become active following an IPOS$^{plus®}$ program restart (F5 A/P-STOP / F9 P-Start, or mains (24V auxiliary operation) turned off and then on again)

You can set up max. 32 data objects for reading in data.

Object structure

H+0	**Object number:** The object number is used for addressing the data object. The object numbers of the sender (TRANSMIT) and receiver (RECEIVE) must be the same for the data exchange.
H+1	**Number of data bytes and data format**

Bit	Value	Function
0...3	0...8	Number of data bytes
4...7	0	Reserved
8	0...1	0 = MOTOROLA format 1 = INTEL format **The format of the sender and receiver must be the same!**
9...31	0	Reserved

H+2	Number of the variable H" from which point the received data is stored Differences in user data formats MOTOROLA and INTEL:

	MOTOROLA format								INTEL format							
CAN Data Byte	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
Variable	H"+1				H"				H"				H"+1			
Variables byte	3	2	1	0	3	2	1	0	0	1	2	3	0	1	2	3

INFORMATION

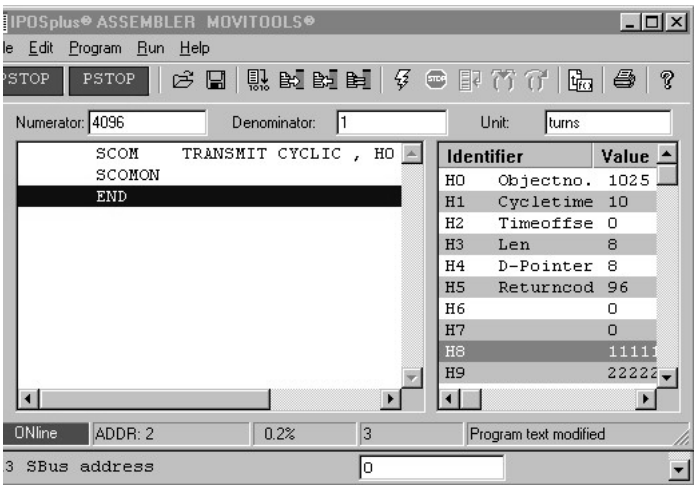
In order to send or receive the data via SBus2, you have to add 0x1000000 to the object number (OR operation).

With the SCOM command, even the variables that can be stored in the non-volatile memory (H0 – H127) and all the parameters are only written in the volatile memory.

Example 1

Cyclical transmission of two variable values (H008 and H009) with the SCOM command from the sender to the receiver to variables H005 and H006.

Sender settings

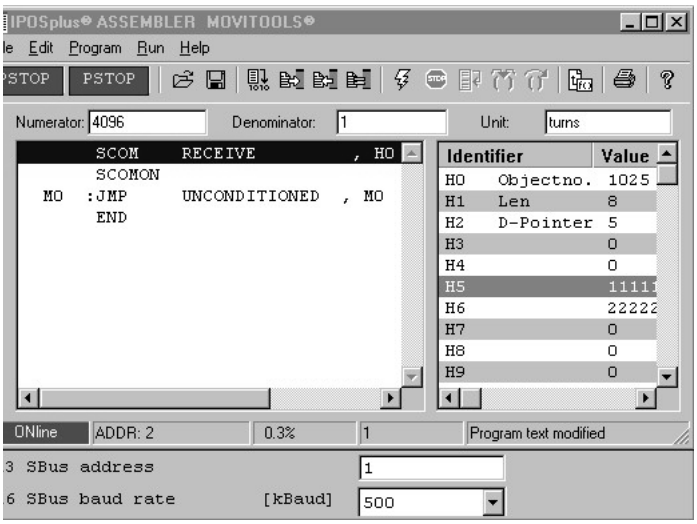


514587147

H0 Objectno.	1025	= user-defined
H1 Cycletime	10	= 10 ms
H2 Timeoffset	0	= no Offset
H3 Len	8	= Variable length 8 bytes
H4 D-Pointer	8	= Data pointer value at H8
H5 Returncode	96	
H8	11111	= sent value

The length of a variable corresponds to 4 bytes. This means for a data length of 8 bytes, two consecutive variables are transmitted.

Receiver settings



514591883

H0 Objectno.	1025	= user-defined
H1 Len	8	= Variable length 8 bytes
H2 D-Pointer	5	= Data pointer value at H5
H5	11111	= sent value

INFORMATION

The synchronization procedure (sync ID) has been modified from MOVIDRIVE A. In contrast to MOVIDRIVE® A, for MOVIDRIVE® B you must ensure that in the IPOS$^{plus®}$ program of the master drive the actual position is initialized **first** and **then** the sync object with SCOM().

23.5.5 SCOMON

System Bus **Com**munication **On**

This command triggers the reception of data or the cyclical transmission of previously defined data objects.

The SCOM command initializes the data objects with the arguments RECEIVE (receiving data) or TRANSMIT CYCLIC (sending data cyclically).

In MOVIDRIVE® B, the command has been replaced by SCOMST. However, due to downward compatibility, it can still be used with MOVIDRIVE® B.

INFORMATION

This command only activates SBus 1, not SBus 2

- Preferably use the SCOMSTATE command.

Structure

Command structure Mxxx SCOMON	Mxxx: Label (optional)

23.5.6 SCOMST

This statement initializes the CAN interface, starts or stops the data reception and the acyclic transmission of predefined data objects via SBus 1 or SBus 2. The data objects re initialized via the SCOM function.

Regardless of the value for "X1", with MOVITRAC® B, the SCOMST X1 command always has the same effect as SCOMON (page 321).

Argument	Meaning
START ALL	Starts cyclical communication synchronously from SBus 1 and SBus 2
STOP ALL	Stops cyclical communication synchronously from SBus 1 and SBus 2
START1	Starts cyclical communication from SBus 1
STOP1	Stops cyclical communication from SBus 1
START2	Starts cyclical communication from SBus 2
STOP2	Stops cyclical communication from SBus 2

Structure

Command structure Mxxx SCOMST X1	Mxxx: Label (optional) X1: Argument

23.6 Positioning commands

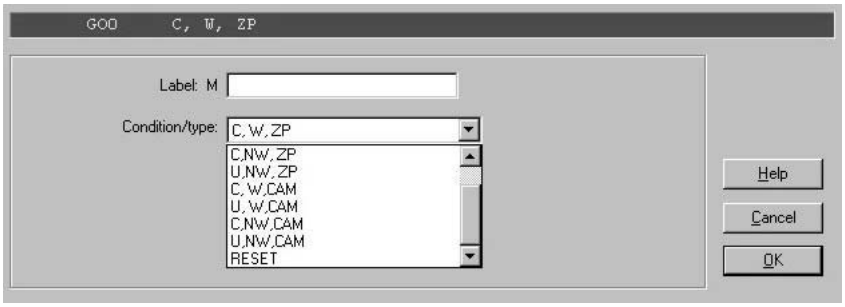
23.6.1 Reference travel GO0

GO0

The GO0 command triggers reference travel or sets an absolute encoder. In doing so, the operating status and the 7-segment display changes from "A" (technology option) to "c" (reference mode). **Operating mode P700** is not affected.

The argument of GO0 and parameters P900 -P903 determine the reference travel behavior.

The argument is a combination of 3 characteristic properties (C/U; W/NW; ZP/CAM) resulting in 8 selection options. RESET can be used to interrupt reference travel.



514597259

C	(conditional)	Only performs reference travel if the drive has not been referenced already (that is, H473, Bit 20 = 0).
U	(unconditional)	Always performs reference travel.
W	(wait)	Waits until the axis has been referenced. No other task is performed in the mean time.
NW	(non-wait)	The next command is processed during reference travel (recommended).
ZP	(zero pulse)	References to the zero pulse of the encoder signal (not significant if 903 = 0 or P903 = 5).
CAM	(reference cam)	References to the reference cam (not significant if 903 = 0 or P903 = 5).
RESET		Reference travel which has started is interrupted (brakes at positioning ramp) and the call is reset. For a reference axis, the message "Axis referenced" is reset and the message "Axis in position" is set.

Parameter settings

P60_	If a reference cam is used, one input must be set to the REFERENCE CAM function.
P900	Reference offset (writes H498).
P901/ P902	Reference speeds.
P903	The reference travel type and the argument ZP / CAM determine the condition required to end reference travel. Example: P903 = 1, GO0 U,W,ZP The zero pulse is evaluated according to the reference cam.
P904	Not significant for GO0.

INFORMATION

The controller must be enabled to set an absolute encoder using the GO0 command. Alternatively, the encoder can be set without an enable by setting the offset P905 for Hiperface® or the parameters P953 ... P955 for an SSI encoder (DIP) .

	INFORMATION For type 3 and 4 and for the **CAM** setting, the drive must be referenced and positioned right next to the hardware limit switch. For hoist applications and the lower reference point in particular, when the drive is positioned to the lower point, it can collide with the hardware limit switch at the slightest overshoot. The same danger applies when the holding brake is released. One way to prevent this from happening is to position the drive once reference travel is complete so that the drive is positioned a sufficient distance away from the hardware limit switch (approximately 0.5 ... 1 motor revolution) .

If the software limit switches have been set via parameter P920/P921, the software limit switches are only monitored once reference travel is complete.

If the drive is not connected to an absolute or Hiperface® encoder, the reference point is lost after an error message occurs and the drive has to be RESET.

	INFORMATION If a waiting referencing command is interrupted by withdrawing the "/controller inhibit", the error code 39 (reference travel) is set. The axis does not start up once the signal has been restored. The IPOS$^{plus®}$ program stops at this command. A reset must be performed (binary input, fieldbus, SHELL ...). The IPOS$^{plus®}$ program starts at the beginning of the first statement.

Structure

Command structure	Mxxx: Label (optional)
Mxxx GO0 X1	X1: Type of reference travel

23.6.2 GOA absolute positioning / GOR relative positioning

The argument of the travel command includes the target position.

	INFORMATION If the target position is specified via a variable, the value can only be entered in increments (based on 4096 increments/motor revolution). Constants can be entered in user travel units.

	INFORMATION If the modulo function is used for positioning, the commands GOA and GOR cannot be used; the target positions are written directly to H454.

There are two types of positioning: absolute and relative.

	INFORMATION Axes turning in one direction, for example, turntables, conveyor belts or roll feeders are usually described as modulo axes (see the modulo function P960 ... P963). In this case, a mechanical position of the axis corresponds to an actual value H455, irrespective of the number of revolutions turned (for prerequisites for this function, see the description of the modulo function).

Parameter settings for all positioning commands

Parameter	Explanation
P913/P914	Travel speeds (can be changed in the program using SETSYS).
P911/P912	Positioning ramps (acceleration) (can be changed in the program using SETSYS).
P915/P203	Precontrol that can be used to influence the jerk.
P933	Jerk limitation (only with MOVIDRIVE® B).
P916	Ramp type.
P917	Ramp mode.

GOA/GO ABSOLUTE

This command performs absolute positioning to the position specified in the second argument X2. Argument X2 can be a constant, variable or an indirect variable.

The target position based on position 0 (machine zero) is entered as the travel distance. The resulting target position is reflected in the system variables H492 (TARGET POSITION).

The message "IPOS in position" is updated within a GOA or GOR command; that is, the message can be queried directly in the next program line.

Structure

Command structure Mxxx GOA X1 X2	Mxxx:	Label (optional)
	X1:	NoWait: Program processing is continued while the drive is still moving. This permits the program to be processed at the same time as the travel movement. Wait: Program processing does not continue until the actual position of the drive has reached the position window P922 of the target position.
	X2:	K = Target position in user units as a constant. H = Target position in user units as a variable. [H] = variable, that contains the target position in increments, based on 4096 increments/motor revolution.

GOR/GO RELATIVE

This command performs relative positioning to the position specified in the second argument X2. Argument X2 can be a constant, variable or an indirect variable.

The entered travel distance is added to the current target position H492 (TARGET POSITION) of the drive and displayed there.

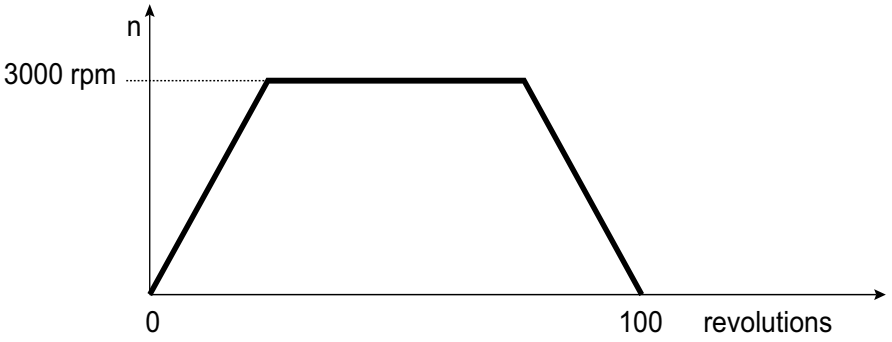
The message "IPOS in position" is updated within a GOA or GOR command; that is, the message can be queried directly in the next program line.

Structure

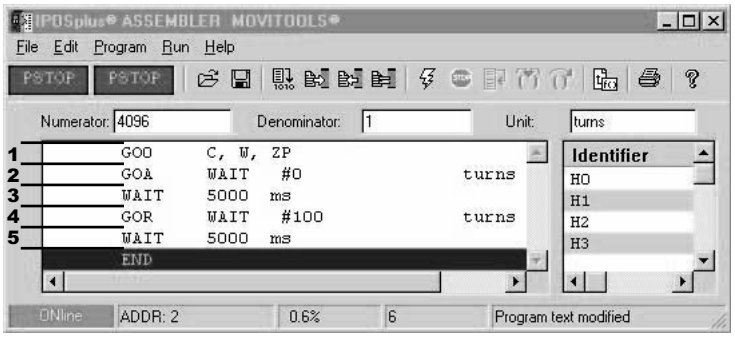
Command structure		
Mxxx GOR X1 X2	Mxxx:	Label (optional)
	X1:	NoWait: Program processing is continued while the drive is still moving. This permits the program to be processed at the same time as the travel movement (recommended). Wait: Program processing does not continue until the actual position of the drive has reached the position window P922 of the target position.
	X2:	K = Target position in user units as a constant. H = Target position in user units as a variable. [H] = variable, that contains the target position in increments, based on 4096 increments/motor revolution.

Example 1

The program shown below causes the drive to travel between the positions 0 revolutions. and 100 revolutions (entry in the program header: numerator, denominator, unit). A waiting period of 5 seconds elapses when a position is reached.



515070219



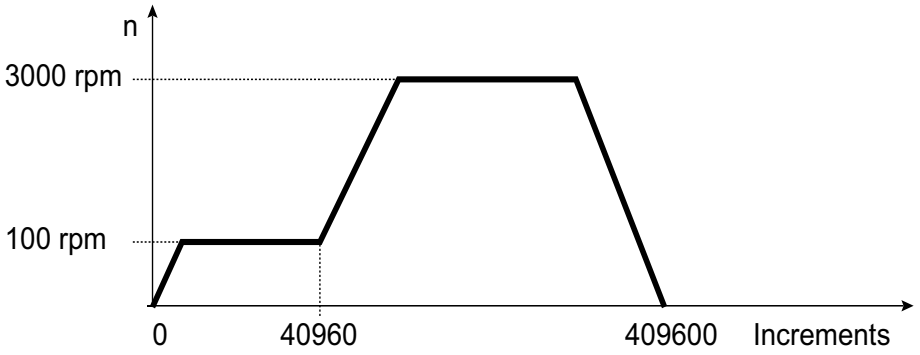
515071755

1. Reference travel
2. Travel to zero
3. Wait 5 s
4. Travel to 100
5. Wait 5 s

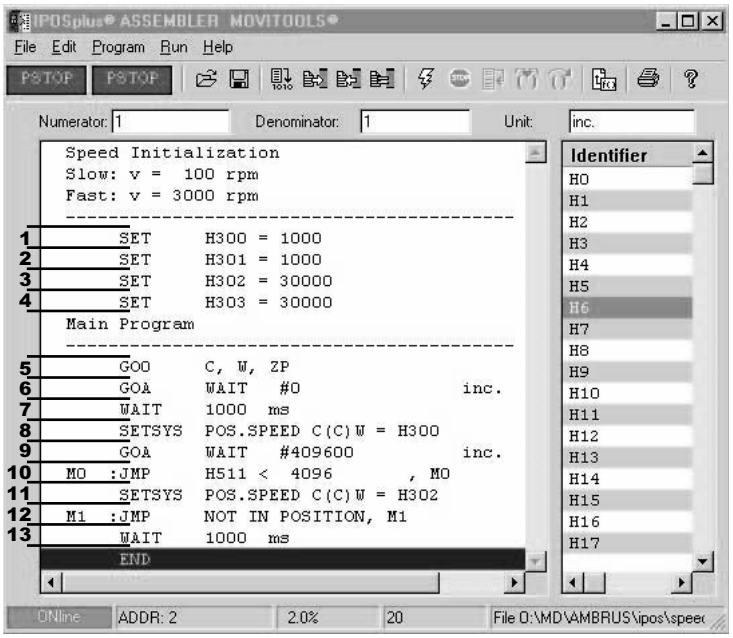
Once the END command has been performed, the IPOS$^{plus®}$ program automatically starts processing from the first line.

Example 2

The program shown below causes movement to take place between the positions 0 and 409600 increments. A waiting period of 1 second elapses when a position is reached. The speed is increased from 100 rpm to 3,000 rpm when the drive moves beyond position 40960. The entire return travel takes place at 3,000 rpm.



515073291



515074827

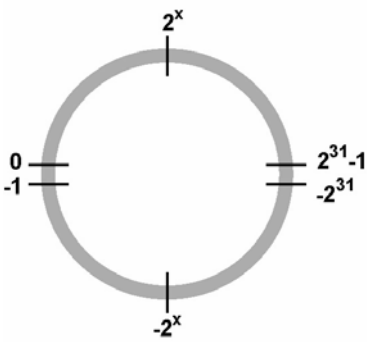
1. Slow CW travel 100 rpm
2. Slow CCW travel 100 rpm
3. Fast CW travel 3000 rpm
4. Fast CCW travel 3000 rpm
5. Reference travel
6. Travel to zero
7. Wait 1 s
8. Set slow speed
9. Travel to end position
10. As long as Actpos Mot (H511) is less than 40960, stay in current line
11. Set fast speed
12. Stay in current line until the drive stops
13. Wait 1 s

Endless positioning

The absolute travel range of IPOS$^{plus®}$ is limited to values in the range -2^{31} ... 0 ... 2^{31} –1. With the relative travel command, a maximum travel distance of 2^{31} can be added to any actual position (see number circle).

An example of infinite positioning is shown in the jog mode sample program.

	INFORMATION The GOR command always refers to target position H492. For example, if the GOR 1000 incr. command is sent 100 times in a program, the target position is set internally to 100 x 1000 increments. The position setpoint may shift away from the actual position of the motor if the command is called up cyclically. The IPOS control may then fail as of a critical value $2^{31}/2$ (drive turns in the opposite direction).



515076363

23.7 Program commands

23.7.1 Program command END

END

The END statement indicates the textual (not logical) end of an IPOS$^{plus®}$ program. The END statement is not an IPOS command; you cannot delete it.

23.7.2 Subroutine call CALL

CALL

Subroutines are called up with a CALL command (CALL Mxx). The corresponding jump flags (Mxx) are inserted in front of the first command in the subroutine. A subroutine ends with a RETURN command (RET). The RETURN command causes program processing to jump back to the line below the CALL command. The following program lines will then be processed. It is also possible to have nested subroutine calls (maximum nesting depth: 32 levels).

INFORMATION

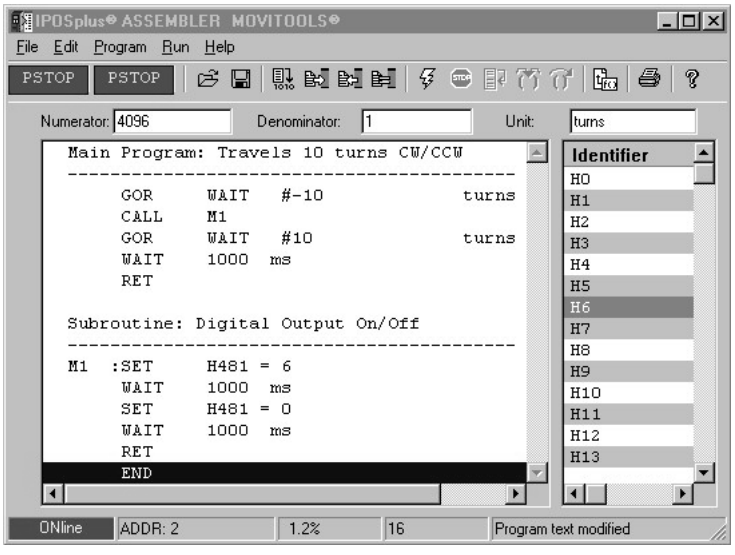
Do not exit subroutines by jumping to a main program or another subroutine. Conditional exiting of the subroutine must be performed by jumping to the end of the subroutine.

Structure

Command structure	Mxxx: Label (optional)
Mxxx CALL Myyy	Myyy = Label as of which subroutine begins.

Example

The main program positions the drive 10 revolutions CCW, after which there is a subroutine call (CALL M1). Set 2 outputs of the basic unit for 1 s (the output parameters must be set to "IPOS-OUTPUT"). The jump back to the main program (RET) takes place next and the GOR WAIT #10 positioning command is processed.



515186699

23.7.3 Jump commands JMP

JMP/terminals

The program jumps to the specified label if the input terminals marked in the mask are all set to level 1 or level 0 (AND relation).

The bits 0 ... 5 indicate the terminals of the basic unit, bits 6 ... 13 the terminals of the option card (DIO11A). The mask is created by entering the terminal levels directly in the input window.

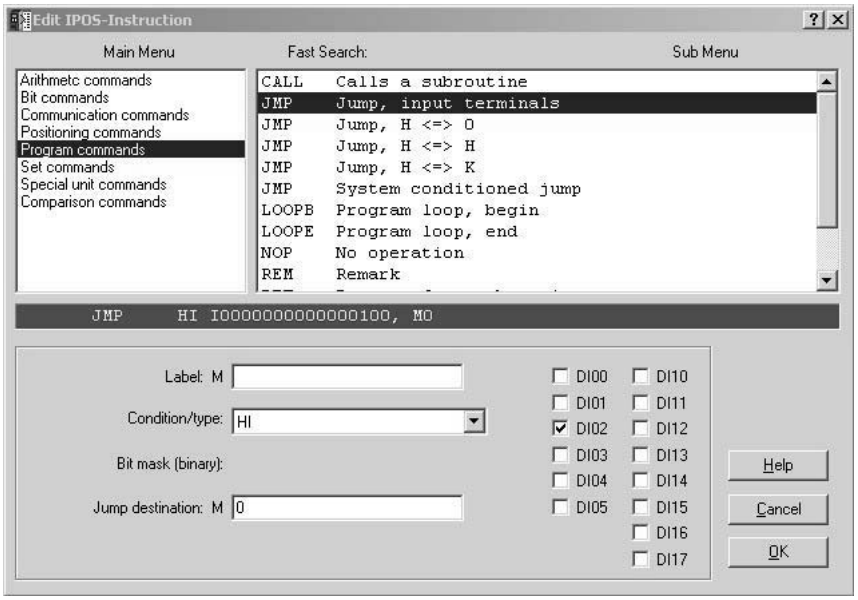
Structure

Command structure Mxxx JMP X1 X2, Myyy		
	Mxxx:	Label (optional)
	X1:	HI= Jump if the input terminals marked in the mask are set to level 1. LO= Jump if the input terminals marked in the mask are set to level 0.
	X2:	Ixxx ... = Mask for the input terminals.
	Myyy:	Jump label to which the program branches.

Example

```
JMP HI I 0000000000000011, M03
```

After the JMP command has been performed, processing continues from the M03 label if the input terminals DI00 and DI01 are set to level 1.



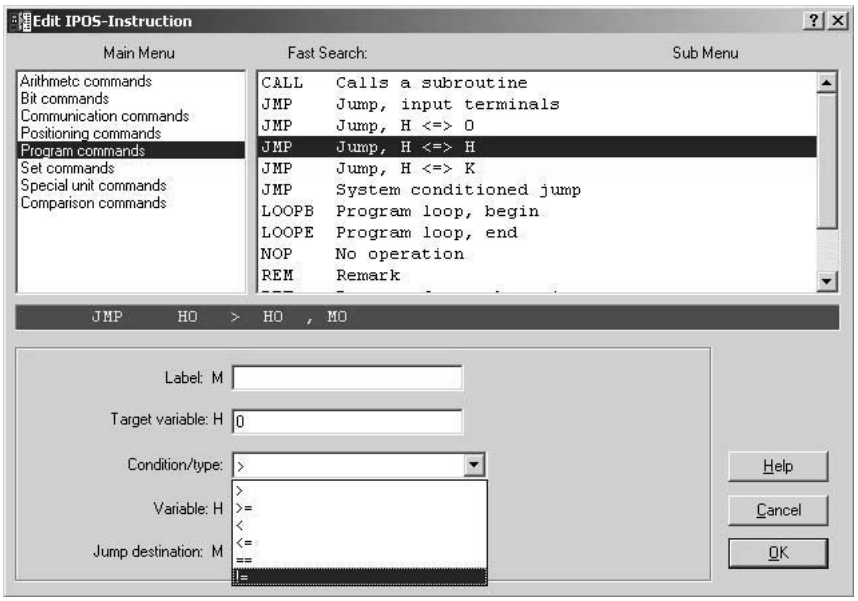
515191051

JMP/comparison

The JPM command causes the program to jump to a specified label when comparison in the command results in a true statement.

Structure

Command structure Mxxx JMP X1 OP X2, Myyy	Mxxx:	Label (optional)
	X1:	Variable
	OP:	Operator: > / > = / < / <= / = / !=
	X2:	H = variable K = constant 0 = zero (in a comparison with zero, only the operators = and != are possible).
	Myyy:	Jump label to which the program jumps if the condition is fulfilled.



515195787

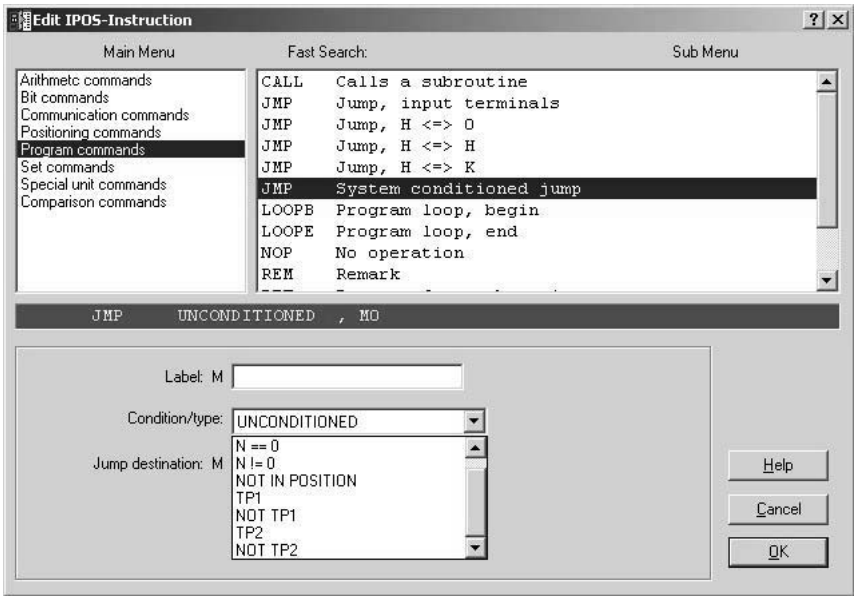
JMP/System

Jumps to the label indicated in the command if comparison operation is fulfilled.

The system values listed can be queried directly by means of a JMP command. Other system values are available as system variables or must be read in using the GETSYS command and processed further.

Structure

Command structure Mxxx JMP X1, Myyy	Mxxx:	Label (optional)
	X1:	UNCONDITIONED: Unconditional jump. N == 0: Jump if the speed is equal to zero. N != 0: Jump if the speed is not equal to zero. NOT IN POSITION: Jump if not in position TP1: Jump if there is an edge change at touch probe terminal DI02. NOT TP1: Jump if there is not an edge change at touch probe terminal DI02. TP2: Jump if there is an edge change at touch probe terminal DI03. NOT TP2: Jump if there is not an edge change at touch probe terminal DI03.
	Myyy:	Jump label to which the program jumps if the condition is fulfilled.



515235723

23.7.4 Loop commands LOOP

	INFORMATION Do not exit program loops with a jump command. Jump commands and subroutines are allowed within a program loop.

LOOPB/LOOP BEGIN

This command in combination with a LOOP command creates a program loop. The number of loop cycles (> 0) is specified as a constant. The loop ends at the associated LOOP command. Program loops can be nested.

If the number of loop cycles is to be variable, a JMP command must be used instead of a LOOP command and the variable condition must be checked at each cycle.

Structure

Command structure		
Mxxx LOOPB X1	Mxxx:	Label (optional)
	X1:	Number of loop cycles (maximum 256)

LOOPE/LOOP END

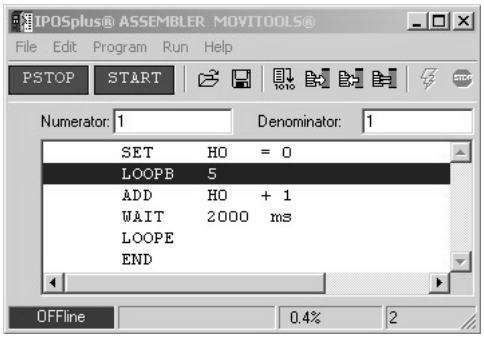
This command specifies the end of a program loop that was started using the LOOPB command.

Structure

Command structure Mxxx LOOPE	Mxxx: Label (optional)

Example

In the example below, variable H0 is incremented from 0 to the value 5 in 5 loop cycles. Program processing starts again with the SET H0 = 0 command after 5 loop cycles.



515243147

23.7.5 No Operation NOP / remark REM / return RET / TASK / TASK2 / wait WAIT

NOP/NO OPERATION

No operation is performed. This command can be used, for example, to achieve wait times on the basis of the command cycle time. In MOVIDRIVE® A, for example, this is 1 command/ms in task 1.

Structure

Command structure Mxxx NOP	Mxxx: Label (optional)

REM/REMARK

The REM command adds a remark line to the program. Remark lines cannot be saved in the inverter. All remark lines are lost after DOWNLOAD of the program followed by an UPLOAD.

Remark lines can only be saved in program files on the PC.

Structure

Command structure REM X1	X1: Any string

RET/RETURN

The RET command terminates a subroutine (see the CALL command) and jumps back to the program from which the subroutine was called. In a main program, the RET command causes a jump back to the beginning of the main program.

Structure

Command structure Mxxx RET	Mxxx:	Label (optional)

TASK

This command is used to define the start address of task 2 and task 3 and to start or stop these with the argument X1 (START/STOP); that is, the control word of the task is written. The control word and start address are both set to 0 when the power is switched on, i.e. Task2 is deactivated.

This command is only available as of MOVIDRIVE® B.

Structure

Command structure Mxxx TASK X1 Myyy	Mxxx:	Label (optional)
	X1:	TASK2 STOP: Stop task 2. TASK2 START: Start task 2. TASK3 STOP: Stop task 3. TASK3 START: Start task 3.
	Myyy:	Label at which the task starts.

Example

```
TASK TASK2 START M03
```

Task 2 is started at this command and the first command after the label M03 is processed parallel to task 1.

TASK2

This command is used to define the start address of TASK2 and to start or stop these with the argument X1 (START/STOP); that is, the control word of TASK2 is written. The control word and start address are both set to 0 when the power is switched on, i.e. TASK2 is deactivated.

In MOVIDRIVE® B, the command has been replaced by TASK. However, due to downward compatibility, it can still be used with MOVIDRIVE® B.

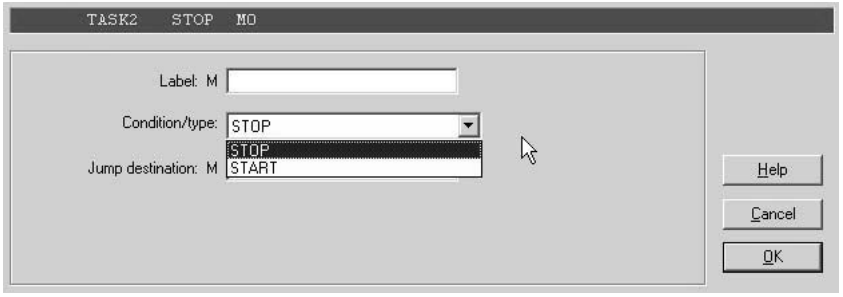
Structure

Command structure Mxxx TASK2 X1 Myyy	Mxxx:	Label (optional)
	X1:	STOP: Stop task 2. START: Start task 2.
	Myyy:	Label at which task 2 starts.

Example

```
TASK2 START M03
```

Task 2 is started at this command and the first command after the label M03 is processed parallel to task 1.



515247499

WAIT

The WAIT command waits for the length of time specified in ms in the argument and then continues program processing for this task once the time is up.

INFORMATION

If the waiting time is to be variable, you will have to initialize a timer (H487 ... H489) instead of a WAIT command and program a loop with the JMP command until the timer has expired.

Structure

Command structure		
Mxxx WAIT X1	Mxxx:	Label (optional)
	X1:	Waiting time in ms, 0 ... 32767.

Example

```
SET H0 = 20000
SET H489 = H0
M01: JMP H489 != 0, M01
```

23.8 Set commands

23.8.1 Copy variables COPY

COPY

The COPY command copies the number of successive variables specified in the 3rd argument. The second argument of the COPY command indicates the number of the first source variable; the first argument indicates the number of the first target variable. Up to 10 variables can be copied using one COPY command.

Structure

Command structure Mxxx COPY X1 = X2, X3	Mxxx:	Label (optional)
	X1:	Hxxx = Number of the first target variable.
	X2:	Hyyy = Number of the first source variable.
	X3:	K = Constant (number of variables to be copied, 1 ... 10).
	Myyy:	Jump label to which the program jumps if the condition is fulfilled.

Example

The command `COPY H2 = H20, 3` corresponds to the command sequence:

```
SET H2 = H20
SET H3 = H21
SET H4 = H22
```

23.8.2 Read system values GETSYS

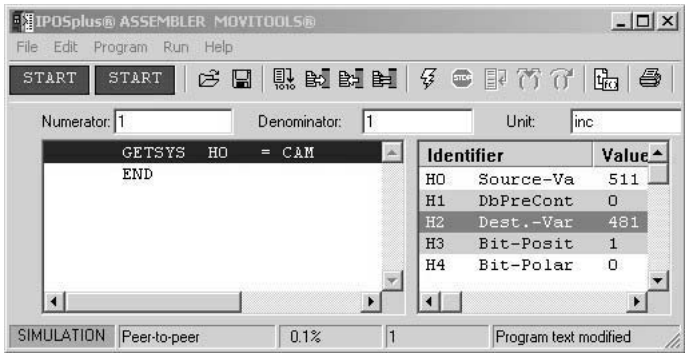
GETSYS/GET SYSTEM VALUE

The GETSYS command loads the value of an internal system value of argument X2 to one or more variables of argument X1.

Structure

Command structure Mxxx GETSYS X1 X2	Mxxx:	Label (optional)
	X1:	Hxxx = Start of the variable structure containing the result after the command has been performed.

X2:	
ACTIVE CURRENT	Active current in 0.1% rated unit current
ACT.SPEED	actual speed in 0.1% rpm
SETP.SPEED	Setpoint speed in 0.1% rpm
ERROR	Error code according to the "Error messages and list of errors" table in the system manual
SYSTEM STATUS	Operating status, value of the 7-segment display without fault status in accordance with the table "Operating display" in the system manual
ACT.POSITION	Actual position depending on the encoder selected in P941 H509, H510 or H511
SETP.POSITION	Setpoint position (current setpoint selection of the profile generator whilst a travel command is being carried out), identical to system variable H491
TARGET POSITION	Target position, identical to system variable H492
INPUTS	Binary inputs H483 (MOVIDRIVE® A) / H520 (MOVIDRIVE® B) of the basic unit and options; identical to system variable H483.
DEVICE STATUS	Identical to status word 1 of the fieldbus unit profile (fault code + operating status)
OUTPUTS	Binary outputs H482 (MOVIDRIVE® A) / H521 (MOVIDRIVE® B) of the basic unit and the option
IxT	Unit utilization in 0.1% rated unit current
ACT.POSITION / SETP.POSITION / TARGET POSITION: Resolution depends on the encoder selected in P941: – Motor encoder: 4096 Inc./revolution – External encoder X14: Encoder resolution P944 – DIP (SSI encoder): Encoder resolution P955	

ANALOG INPUTS	-10 V ... 0 ... +10 V = -10000 ... 0 ... 10000	
	H+0	Voltage value analog input 1 [mV]
	H+1	Voltage value analog input 2 [mV]
CAM		The **GETSYS H = CAM** command simulates a cam controller. Using the GETSYS command, a standard cam controller with 1 output per cam can be used per drive. With MOVIDRIVE® units, you can use an extended cam controller with 8 outputs. Hxx is the first variable of a data structure (CamControl). The bit with the highest significance (bit 31) is used in Hxx to decide which cam controller the GETSYS command refers to. Bit 31 = 0: Standard cam controller (all MOVIDRIVE® units). The GETSYS command activates the cam controller. The cams are formed once when the GETSYS command is processed. If the standard cam controller is to process cyclically, the command must be called up cyclically. Bit 31 = 1: Extended cam controller with technology option and CFC or SERVO mode). The GETSYS command activates the cam controller, the cams are formed cyclically in the background. The structure of the variables depends on whether the standard or expanded cam controller is called. The data structure is described in section "Position Detection and "Positioning/cam controllers".  515353867
ANALOG OUTPUTS	+/- 10 V correspond to +/- 10000	
	H	The variable in the GETSYS H = ANALOG OUTPUTS command defines the beginning of the following variable structure.
	H+0	Contains the voltage value of analog output 1 (AO1)
	H+1	Contains the voltage value of analog output 1 (AO2)
TIMER 0		Loads the current value of timer 0 [ms], identical to system variable H489
TIMER 1		Loads the current value of timer 1 [ms], identical to system variable H488
PO-DATA		Reads the PO data buffer (data sent from the master to the unit). 3 PO or 10 PO data items are read depending on the number of PO data items.
	H+0	Bus type 0 = reserved 1 = TERMINAL 2 = RS-485 3 = Fieldbus 4 = reserved 5 = SBus 8 = SBus 2 (only MOVIDRIVE® B)
	H+1	Number of PO data
	H+2	PO1
	H+3	PO2
	H+4	PO3
	H+5	PO4
	H+6	PO5
	H+7	PO6
	H+8	PO7
	H+9	PO8
	H+10	PO9
	H+11	PO10
DC-VOLTAGE		DC link voltage [V]

RELATED TORQUE **REL. TORQUE VFC**		Relative torque/relative torque VFC. The relative torque is the display value based on the rated unit current for the torque at the motor output shaft. The absolute torque can be calculated from this value using the following formula: $M_{abs} = M_{rel} \times I_N \times M_N / (1000 \times I_{QN})$ M_{abs} = absolute torque I_N = Rated unit current M_{rel} = relative torque based on 0.1% I_N M_N = Rated torque of the motor [Nm] I_{QN} = Rated Q current [A] for selected connection type. The value is available in the operating modes CFC and SERVO / VFC1, VFC1 & hoist, VFC1 & DC braking and VFC1 & flying start.
ACT. SPEED EXT.		Actual speed of the external encoder X14. The following data structure is used:
	H	Time Base 5 ms ... 31 ms: Mean value for speed detection of external encoder.
	H+1	Encoder type 0 = Encoder X14 1 = DIP encoder
	H+2	Numerator -2^{15} ... 0 ... + 2^{15} -1: Numerator for user scaling.
	H+3	Denominator 1 ... 2^{15} -1: Denominator for user scaling.
	H+4	D-Pointer 0 ... 458: Pointer to result variable H".
	H'	Result unit: [nX14] = Inc/Time base.

	Example: The speed of the master encoder is to be displayed in arcs per hour. With an average value filter of 30 ms and encoder X14, the arcs per hour are calculated as follows:
	11250 / 384 = (1000 ms × 60 s × 60 min) / (Incr. per full load revolution × TimeBase)
	The minus sign at H32 causes the direction of rotation to be reversed.
	`SET H30 = 30`
	`SET H31 = 0`
	`SET H32 = -11250`
	`SET H33 = 384`
	`SET H34 = 40`
	`GETSYS H30 = ACT.SPEED EXT.`	

SPEED MON. TIMER		Numerator value of the speed monitoring. The GETSYS command can be used as a prewarning for speed monitoring. Speed monitoring is triggered when the current is at the current limit for the number of seconds specified in P501. For example, if P501 = 200 ms, the numerator value can be queried with GETSYS. In this way, return travel can be made at rapid speed and, when under load, the speed can be reduced automatically by the inverter.

23.8.3 Set commands variable SET / fault response SETFR / Indirect addressing SETI / Interrupt SETINT / system values SETSYS

SET

The SET command loads argument X1 with the content of argument X2 (variable H or constant K). The result is written to argument X1, argument X2 remains unchanged.

Structure

Command structure Mxxx SET X1 = X2	Mxxx:	Label (optional)
	X1:	Hxxx = Result of the statement.
	X2:	Hyyy = Source.

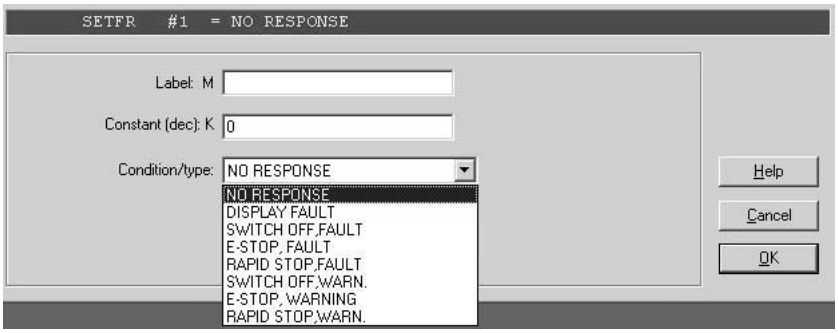
SETFR/SET FAULT REACTION

The SETFR command defines the response to a unit fault. The fault code is entered in argument X1 of the command. The reaction to the unit fault is selected with argument 2. The selected fault reaction will only be executed once the SETFR command has been processed. The **most recently** selected fault response (call of the SETFR command or changes in P83_ "Fault response") is the one in effect.

You can program all responses to a fault as long as it has a point in column "P" in the fault list in the operating instructions or the system manual.

Example:

- Fault 27 "Limit switches missing", no point in column P: Cannot be programmed
- Fault 28 "Fieldbus timeout", point in column P: programmable



515358219

Structure

Command structure Mxxx SETFR #X1 = X2	Mxxx:	Label (optional)
	X1:	Fault code of the fault for which the response is to apply. The following error numbers are permitted: 08: n-monitoring 11: Overtemperature 26: External terminal (P830) 28: Fieldbus timeout (P831) 31: TF sensor (P835) 39: Reference travel 42: Lag error (P834) 43: RS-485 timeout (P833) 47: SBus timeout (P836) 77: IPOS control word 78: IPOS software limit switch (P838) 84: Motor protection (P832) 92: DIP operating range 93: DIP absolute encoder

X2:	
NO RESPONSE	**No response** (and no fault display).
DISPLAY FAULT	**No response, only the fault is displayed** (the terminal level of an output programmed to "/FAULT" is set from 1 to 0).
SWITCH OFF, FAULT	**The output stage is inhibited, no torque, the brake is activated.** After reset: Response as for power off/on: The IPOS$^{plus®}$ program, reference position, outputs, parameters (SETSYS command) and variables set by IPOS$^{plus®}$ are reset (program starts in line 1).
E-STOP, FAULT	**The drive is stopped at the emergency stop ramp.** After reset: Response → SWITCH OFF, FAULT.
RAPID STOP, FAULT	**The drive is stopped at the rapid stop ramp.** After reset: Response → SWITCH OFF, FAULT.
SWITCH OFF WARNING	**The output stage is inhibited, no torque, the brake is activated.** IPOS$^{plus®}$ program continues, reference position, outputs, parameters (SETSYS command) and variables set by IPOS$^{plus®}$ are retained.*
E-STOP, WARNING	**The drive is stopped at the emergency stop ramp.** IPOS$^{plus®}$ program keeps running, → SWITCH OFF, WARNING.*
RAPID STOP, WARNING	**The drive is stopped at the rapid stop ramp.** IPOS$^{plus®}$ program keeps running, → SWITCH OFF, WARNING.*
* even after fault confirmation	

SETI/SET INDIRECT H = [H]

Variable X1 gets the value of variable whose number is contained in variable X2.

	INFORMATION Is the number of the indirectly addressed variables outside the defined range (e. g. MOVIDRIVE® A range 0 ... 512), the fault message IPOS INDEX OVERFL (32) is generated.

Structure

Command structure Mxxx SETI X1 = [X2]	Mxxx:	Label (optional)
	X1:	Hxxx = Target variable.
	X2:	Hyyy = Number of the source variable.

Example

```
SET H1 = 7
SET H7 = 11
SET H3 [H1]
```

After the program has been run, the variables have the following values:

H1 = 7

H7 = 11

H3 = 11

SETI/SET INDIRECT [H] = H

The variable with the number in variable X1 gets the value from variable X2.

	INFORMATION Is the number of the indirectly addressed variables outside the defined range (e. g. MOVIDRIVE® A range 0 ... 512), the fault message IPOS INDEX OVERFL (32) is generated.

Structure

Command structure Mxxx SETI [X1] = X2	Mxxx:	Label (optional)
	X1:	Hxxx = Number of the target variable.
	X2:	Hyyy = Source variable.

Example

```
SET H01 = 50
SET H0 = 10
M01 :SETI  [H0] = H01
 ADD H0 + 1
ADD H01 + 10
 JMP H0 <= 15 , M01
```

After the program has been run, the variables have the following values:

H10 = 50

H11 = 60

...

H15 = 100

SETINT/SET INTERRUPT

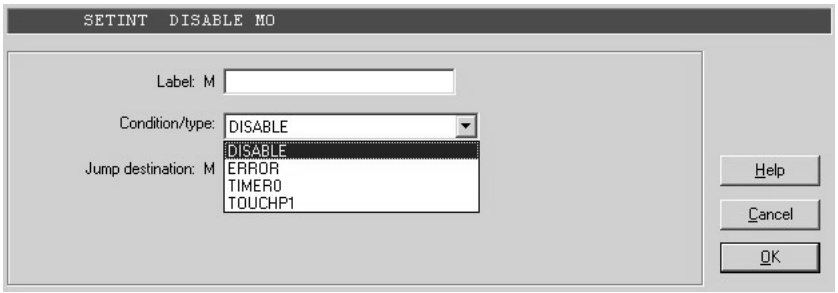
The SETINT command sets the start address of an interrupt routine. The address is indicated as label in the command. An interrupt may be triggered by various events. The events are specified in Argument X1. The interrupt routine itself must be completed with a RET command.

A jump to the interrupt routine takes place immediately and independent of the currently processed main program line. If the interrupt routine ends with the RET command, program processing continues from the point where the interruption occurred (processing of an interrupted "wait command" is continued).

The SETINT command is only in effect in task 1 and processing of task 1 is interrupted whilst the interrupt is processed.

It is only possible to process one interrupt at a time, although an interrupt with a higher priority can interrupt the processing of another interrupt. ERROR has the highest priority, then TOUCH PROBE, followed by TIMER 0.

An interrupt only has to be initialized once using SETINT.



515362827

Structure

Command structure Mxxx SETINT X1, Myyy	Mxxx: Label (optional)

X1:	
DISABLE	Deactivating the interrupt, the jump flag (Mxx) is of no importance.
ERROR	Triggers an interrupt in case of a unit fault. The interrupt routine runs cyclically until the error has been removed, at which point, the routine is left using the RET command. Depending on the set fault reaction (**parameter group 830** or **SETFR** command), processing of the interrupt routine will result in a behavior other than the one described above: • No interrupt is performed if the faults in parameter group 830 are set to "No response" or if the SETFR command is set to NO RESPONSE. • The program is restarted (see the SETFR command) after acknowledgment of the fault, if the fault response (**parameter group 830** or the **SETFR** command) is set to "..., **FAULT**". Any reference ID that has been set is lost.
TIMER 0	Triggers an interrupt when the time set in Timer 0 H489 has elapsed. An "auto reload" with the system variable H485 takes place after Timer 0 has elapsed. This reload value determined the time with which the interrupt routine is executed cyclically.
TOUCH PROBE	Triggers an interrupt when there is a change of signal level on the touch probe terminal DI02, if the touch probe was activated for terminal DI02 (parameter P601 = IPOS INPUT) and the TOUCHP command was transmitted.

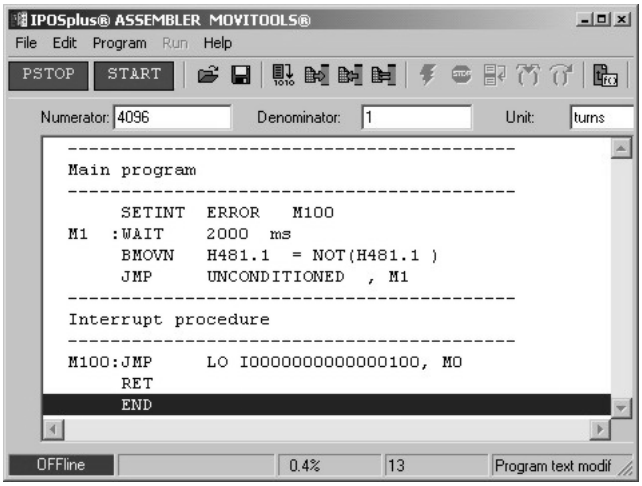
	Myyy: Start label of the interrupt routine.

Example 1

Interrupt branch in the event of a unit fault

In the sample program, binary input DO01 is toggled after a 2 sec pause. The program branches to the interrupt routine immediately if a unit fault occurs. The system returns (RET) to the main program as soon as there is a "high" signal at terminal DI02. To reset the fault, the parameter for input DI02 should be set to "Reset".

MQX unit errors can set the interrupt to ERROR. Unit errors from the connected MOVIMOT® cannot trigger the interrupt.



515392779

Example 2

The following example illustrates the principle of this process:

```
M0   :SETINTERROR M01
 JMP UNCONDITIONED , M0
M01 :ADD H0 + 1
RET
END
```

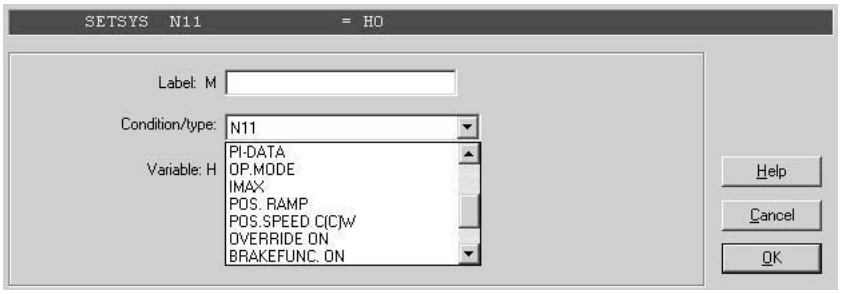
H0 counts up as long as the unit error still occurs. After the fault reset, H0 contains the value from the EEPROM, for example, 0. The value from the working memory calculated during the error is lost

23.8.4 SETSYS

The SETSYS command writes the value of one or more variables to an internal system value. The first argument selects the system value to be written whilst the second argument contains the number of the (first) source variable.

The system values are reset to their original values when the system is switched off (mains and 24 V power).

	INFORMATION Writing system values can alter unit settings that have been made for the application during startup. In particular, changes to positioning ramps and the maximum current must be adapted to the features of the system to preclude the risk of damage and hazards (e.g. due to mechanical overload).



516336139

Structure

Command structure Mxxx SETSYS X1, X2	Mxxx:	Label (optional)

	X2:	Number of the first source variable.

X1: System values that can be selected		
	The internal fixed setpoints (parameter group P160/P170) can be altered in steps of 0.1 rpm using the IPOS$^{plus®}$ program (even during travel if there is no controller inhibit). Note: The new fixed setpoint is only adopted after 5 ms. You may want to delay program processing after a SetSys command with a wait command (5 ms). If the fixed setpoint value exceeds the permitted range, the algebraic sign changes.	
N11 =	Internal fixed setpoint n11	
N12 =	Internal fixed setpoint n12	
N13 =	Internal fixed setpoint n13	
N21 =	Internal fixed setpoint n21	
N22 =	Internal fixed setpoint n22	
N23 =	Internal fixed setpoint n23	
PI DATA[1)]	Process input data according to the fieldbus unit profile	
	H	Number of PI data items
	H+1	PI data 1
	H+2	PI data 2
	H+3	PI data 3
OP. MODE	Sets the operating mode The operating mode can only be changed within the same control procedure (CFC or SERVO) (even during travel if there is no controller inhibit).	
	11	CFC (speed control)
	12	CFC & torque control
	13	CFC & IPOS (positioning)
	14	CFC & synchronous operation (DRS11A)
	16	SERVO (speed control)
	17	SERVO & torque control
	18	SERVO & IPOS (positioning)
	19	SERVO & synchronous operation (DRS11A)
IMAX	Setting the maximum current (only parameter set 1) as a percentage of the unit rated current (setting range: 0,1 ... 150%, in 0,1% steps); settings can also be made during travel.	
POS. RAMP	Positioning ramps (up/down); settings can also be made during travel (only for the "linear" ramp type). Setting in ms with reference value 3000 rpm.	
	H	Positioning ramp 1 (up)
	H+1	Positioning ramp 2 (down)
POS. SPEED	Positioning speed (cw/ccw); settings can also be made during travel (only for the "linear" ramp type). Setting in 0.1 rpm.	
	H	Positioning speed CW
	H+1	Positioning speed CCW
OVERRIDE ON	Switching override on/off; settings can also be made during travel (only for the "linear" ramp type).	
	H = 0	off
	H = 1	On
BRAKE FUNC. ON	Switching the brake function on/off	
	H = 0	off
	H = 1	On
RAMP TYPE	You should not make settings during travel (torque shocks!). Changes P916)	
	H = 0	Linear
	H = 1	sine
	H = 2	square
	H = 3	Bus ramp
	H = 4	jerk limited
	H = 5	Electronic cam
	H = 6	I-synchronous operation
RESET ERROR	Resets the system error in variable X2	

ACT. POSITION	Sets the motor encoder actual position ACTPOS.MOT (H511)
SPLINE MULTIAXIS	Internal drive calculation of an analytical cam disk. The function is only available in MDX B with SD version -15C.
	The spline calculation is initialized via the system function after up to 20 curve points (x-y = value pairs, x = master position, y = slave position) have been specified in a master encoder range. The calculation is then started using `h+0 SplineMode` and either a complete cam disk or one segment of a selected cam disk is filled. Currently, a spline 0 procedure (for optimum running) and a spline 1 procedure (for section-by-section movements and straight sections) are available. The calculation is complete after ≤ 200 ms. – H+0 = SplineMode: (Value range: 0 ... 3) • = 0: Interpolation not active, or calculation is finished • = 1: Start interpolation, enter interpolated values from index 0 starting with the electronic cam (in ascending order, from index 0 to 512). • = 2: Start interpolation, enter interpolated values from index 512 starting with the electronic cam (in descending order, from index 512 to 0). • = 3: Preparatory parameter calculation for interpolation concluded; start entering interpolated values in the electronic cam. – H+1 = SplineModeControl: Reserved – H+2 = SplineDest: (Value range: 0 ... 5) Number of the electronic cam in which the interpolated values are to be entered. – H+3 = SplineNUser: (Value range: 2 ... 10) Number of curve points to be used for interpolation and the calculation process (bit 7 = 0 spline 0, bit 7 = 1 spline 1) – H+4 = SplineX0User: (Only a value >= 0 can be entered here!) X value of the first curve point – H+5 = SplineY0User: (Value range: long = -2^{31} ... 0 ... (2^{31} -1)) Y value (= position value) of the first curve point – ... – H+42 = SplineX19User: (Only a value <= 512 can be entered here!) X value of the 20th curve point – H+43 = SplineY19User: (Value range: long = -2^{31} ... 0 ... (2^{31} -1)) Y value of the 20th curve point
	SS_MULTIAXIS: Total drive calculation of a trajectory. Only available on request. Also refer to the addendum to the "Special Design SK-0C for Caluculated Curves" operating instructions.

1) Applies if parameter P101 is set to "RS485", "Fieldbus" or "SBus".

23.8.5 VARINT

Syntax

```
VARINT Hxx, Mxx
```

Description

This command is not available in MOVIDRIVE® A, only as of MOVIDRIVE® B.

The command activates a variable interrupt with the data structure as of variable Hxx.

If the condition for the interrupt is fulfilled and task 2 or 3, in which this interrupt is processed, is started, the commands are performed as of the label Mxx. The event for the interrupt is the comparison with a variable value (see H+4). If the data structure has been initialized, during run time the behavior of the interrupt can be dynamically adapted to a complete VarInterrupt using an IPOS$^{plus®}$ command.

Note: The data from the data structure is only transferred when the command `VARINT Hxx, Mxx` is called (data consistency).

Example: If the value from the data structure Hx+3 CompareVar is changed, for example, the value is only taken into account with the command `VARINT Hxx, Mxx`.

Key points

Hxx First variable of a data structure (see table H+0)

Mxx Label with the first command of the interrupt function.

Data structure of the variable interrupt:

Variable	VARINT element structure	Description
H+0	Control	0: All VarInterrupt = OFF/Reset 1: Interrupt gets computing time from task 2 and interrupts this task for as long as the interrupt is processed. 2: Interrupt gets computing time from task 3 and interrupts this task for as long as the interrupt is processed.
H+1	IntNum	0 ... 3: Defines a sequential number of the VarInterrupt. An interrupt with the number x, which has already been activated, can be reactivated during the program run time with another data structure using the command call `VarInt Hxx, Mxx` when the same interrupt number is specified in the new data structure at the position H+1. This feature is not available for the task 1 interrupts.
H+2	SrcVar	Number of the reference variable whose value is compared with the comparison value. ScrVar is the value of the reference variable that ScrVar refers to.
H+3	CompVar	Comparison value or mask used to compare the value of the H+2 reference variable.

Variable	VARINT element structure	Description
H+4	Mode	0: No interrupt event. This can be used to deactivate this one interrupt without deactivating them all. 1: One of the bits of the reference variable, masked out using the CompVar mask, has changed its status: ([*SrcVar(t) ^ *SrcVar(t-T)] & CompVar) != 0 2:As long as the value of the reference variable is equal to the comparison value (*SrcVar == CompVar) 3:As long as the value of the reference variable is not equal to the comparison value (*SrcVar != CompVar) 4:As long as the value of the reference variable is greater than or equal to the comparison value (*SrcVar >= CompVar) 5:As long as the value of the reference variable is less than or equal to the comparison value (*SrcVar <= CompVar) 6: Value of the reference variable AND the comparison value is not 0 ((*SrcVar & CompVar) != 0) 7: Value of the reference variable AND the comparison value is 0 ((*SrcVar & CompVar) == 0) 8: Positive edge of the bit masked out by CompVar 9: Negative edge of the bit masked out by CompVar 10: As 2; however, interrupt is only processed once each time the condition is fulfilled (edge triggered) 11: As 3; however, interrupt is only processed once each time the condition is fulfilled (edge triggered) 12: As 4; however, interrupt is only processed once each time the condition is fulfilled (edge triggered) 13: As 5; however, interrupt is only processed once each time the condition is fulfilled (edge triggered)
H+5	Priority	Priority of the interrupt (1 ... 10); task 2 and task 3 are both assigned the priority 0.
H+6	IntEvent	Process image of the reference variable from *SrcVar to the time of the interrupt.

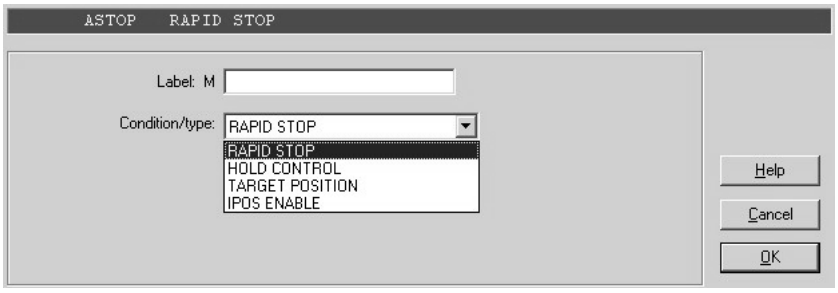
Example See "Task Management and Interrupts / Variable Interrupts with MOVIDRIVE® B".

23.9 Special unit commands

23.9.1 ASTOP / MEM / TOUCHP / WDOFF / WDON

ASTOP/AXIS STOP

The ASTOP command is used to stop or re-enable the drive (see H484 bit 1). The argument of the command (RAPID STOP, HOLD CONTROL, TARGET POSITION) defines the stop type (ramp, control when stopped, etc.) or re-enables the drive (IPOS ENABLE).



516341515

Structure

Command structure Mxxx ASTOP X1	Mxxx: Label (optional)

X1:	
RAPID STOP	Braking with the rapid stop ramp followed by speed control. The last target position (H492) to have been transmitted is retained. Inhibit via control word (command ASTOP (IPOS ENABLE) is required before the subsequent travel command). The brake is applied if the brake function is activated.
HOLD CONTROL	Braking with the ramp of the basic unit (P131/P133) followed by position control. The last target position (H492) to have been transmitted is retained. Inhibit via control word (the ASTOP (IPOS ENABLE) command is required with the subsequent travel command). The brake is **not** applied if the brake function is activated.
TARGET POSITION	Positioning stop with positioning ramp (P911/P912) and calculated "STOP" target position (only possible in the positioning mode), followed by position control. The last target position (H492) to have been transmitted is overwritten by the stop position. No inhibit via control word (no ASTOP (IPOS ENABLE) command required before the subsequent travel command). The brake is **not** applied if the brake function is activated. Note: Since the actual position is used as the setpoint position at standstill, the command cannot be processed cyclically. This is the case in axes with process forces or hoists because otherwise the axis drifts slowly out of position.
IPOS ENABLE	The inhibit is revoked using the IPOS$^{plus®}$ control word.

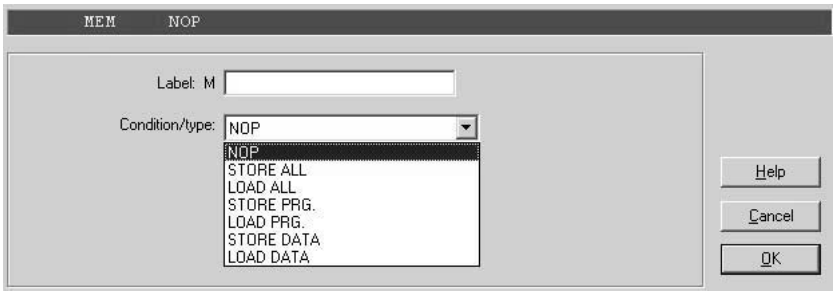
MEM/MEMORIZE

The MEM command makes it possible to save (load) IPOS$^{plus®}$ programs and/or variables in (from) the non-volatile memory on (to) the unit. The action is specified via the argument.

INFORMATION

When using the MEM command note that the variables stored in the non-volatile memory (H0 – 127) and all parameters are not written cyclically. This is because the number of storage operations with the storage medium (EEPROM) is restricted to 10^5 storage operations.

Individual variables can also be stored using the MOVILINK command.



516345867

Structure

Command structure Mxxx MEM X1	Mxxx: Label (optional)

X1:	
NOP	No data is stored
STORE ALL	Programs and data in the working memory are saved in the non-volatile memory (EEPROM)
LOAD ALL	Programs and data are loaded from the non-volatile memory (EEPROM) to the working memory.
STORE PROG.	Only the program from the working memory is saved to the non-volatile memory (EEPROM)
LOAD PROG.	Only the program from the non-volatile memory (EEPROM) is loaded to the working memory.
STORE DATA	Only the variables from the working memory are saved to the non-volatile memory (EEPROM)
LOAD DATA	Only the variables from the non-volatile memory are loaded (EEPROM) to the working memory.

Example

If an error occurs, the program jumps to an error interrupt routine. Here, the MEM STORE DATA command is called so that you can continue processing with the stored interim status of variables H0 ... H127 after the error reset.

If you do not use this command, the program starts with the most recent values from EEPROM and overwrites the most recent working values.

TOUCHP/TOUCH PROBE

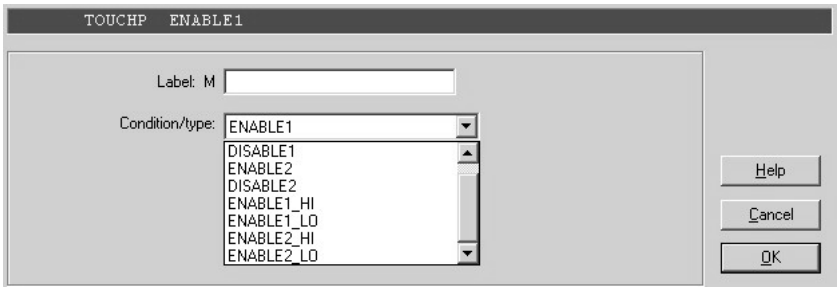
The command **TOUCHP** enables or locks a touch probe input. The touch probe function is generally assigned to the input terminals DI02 and/or DI03. Inputs used for the touch probe function should be set to "IPOS input" to prevent them being allocated twice.

If there is a change of signal level at a touch probe input after the TOUCHP command has been carried out, the current actual positions (H511, H510, H509) are stored in the variables intended for this purpose (H502 – H507) once.

A counter is only available in MQX and MOVITRAC® 07 with variable H511. To take another measurement, the touch probe must be enabled again.

It takes 100 µs to store the touch probe positions, regardless of ongoing program processing. The terminal level must have been altered for at least 200 µs to be detected reliably.

The argument can be used to select the edge change that causes a touch probe.



516734219

The touch probe positions are stored in the following variables:			
Encoder	Encoder position	Position Touch probe 1 (DI02)	Position Touch probe 2 (DI03)
Motor encoder (X15)	H511 ACTPOS. MOT	H507 TP.POS1MOT	H505 TP.POS2MOT
External encoder (X14)	H510 ACTPOS.EXT	H506 TP.POS1EXT	H504 TP.POS2EXT
Absolute encoder (X62)	H509 ACTPOS.ABS	H503 TP.POS1ABS	H502 TP.POS2ABS
Virtual encoder (only for MOVIDRIVE® B)	H376	H501 TpPos1_VE	H500 TpPos2_VE

Structure

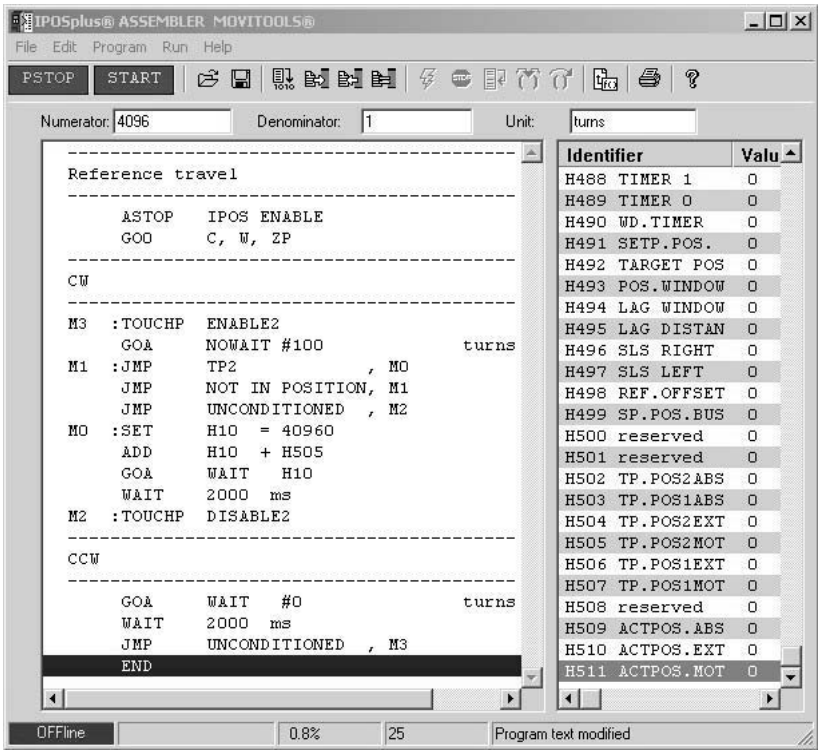
Command structure Mxxx TOUCHP X1	Mxxx: Label (optional)

X1:	
ENABLE 1	Enables the touch probe input DI02. When the signal changes low/high and high/low, the actual positions are stored.
DISABLE 1	Inhibits the touch probe input DI02
ENABLE 2	Enables the touch probe input DI03. When the signal changes low/high and high/low, the actual positions are stored.
DISABLE 2	Inhibits the touch probe input DI03
ENABLE 1_HI	Enables the touch probe input DI02. When the signal changes low/high, the actual positions are stored.
ENABLE 1_LO	Enables the touch probe input DI02. When the signal changes high/low, the actual positions are stored.
ENABLE 2_HI	Enables the touch probe input DI03. When the signal changes low/high, the actual positions are stored.
ENABLE 2_LO	Enables the touch probe input DI03. When the signal changes high/low, the actual positions are stored.

The user can determine whether a touch probe input has been activated either in the program, for example, with a MP TP2, M0 or with the SETINT TOUCHP1 M0. The user can determine whether a stored position value lies in a specific position range by comparing the values with those in the following user program.

Example 1

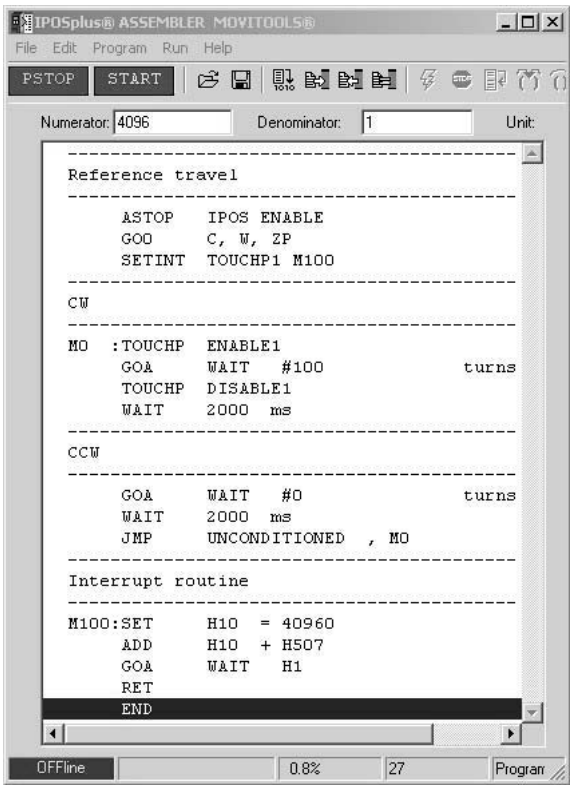
In the program, the drive travels between the absolute positions 0 revs. and 100 revs. If there is a change of signal level at touch probe input DI03 whilst the drive is moving to the target position of 100 revs., a further 10 revs. (40960 incr.) is traveled from precisely this touch probe position. For return travel to position 0, the touch probe function is deactivated using the command DISABLE2.



516738571

Example 2

As an alternative to the example above, a program branch (jump flag M100) can be executed when the touch probe position is reached. This is achieved using the "SETINT TOUCHP1 M100" command.



516742923

WDOFF/WDON / WATCH DOG OFF/ON

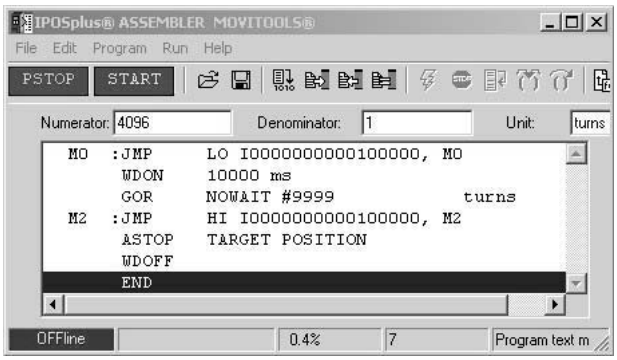
The watchdog is called up in the time interval specified in the argument. All tasks are halted and the drive is stopped with fault 41 if the time specified in the watchdog timer H490 elapses before the monitoring function is switched off using the WDOFF command. (The output stage is inhibited and the brake is applied. The drive coasts to a halt if there is no brake.)

Structure

Command structure		
Mxxx WDON X1 Mxxx WDOFF	Mxxx: X1:	Label (optional) Interval in ms in which the watchdog is called up.

Example

The drive moves for as long as the level at DI05 is set to 1 ("high"). The "watchdog" function ensures that the drive does not travel for more than 10 s. If the 10 second limit is exceeded, the drive is stopped.



516804619

23.10 Comparison commands

23.10.1 Comparison operations CPEQ / CPGE / CPGT / CPLE / CPLT / CPNE

A variable is compared with a 2nd argument (variable or constant). The following comparisons are possible:

- Equal to (CPEQ)
- Greater than or equal to (CPGE)
- Greater than (CPGT)
- Less than or equal to (CPLE)
- Less than (CPLT)
- Not equal to (CPNE)

The result can be processed further with a subsequent jump command.

CPEQ/COMPARE EQUAL

The CPEQ command compares, observing the signs, whether variable X1 is the same as variable or constant X2. Variable X1 contains the result. It is not equal to zero if the condition is fulfilled; otherwise, the result is zero.

The result can be processed further, for example, with a subsequent jump command. Variable X2 remains unchanged.

Structure

Command structure Mxxx CPEQ X1 == X2	Mxxx:	Label (optional)
	X1:	Variable (result)
	X2:	Variable or constant

Example 1

```
SET H0 = 13
SET H1 = 50
CPEQ H0  == H1
```

After the program has been processed, H0 has the value zero and H1 the value 50.

Example 2

```
SET H0 = 13
CPEQ H0  == 13
```

After the program has been processed, H0 has the value one.

CPGE/COMPARE GREATER OR EQUAL

The CPGE command compares, observing the signs, whether variable X1 is greater than or equal to the variable or constant X2. Variable X1 contains the result. It is not equal to zero if the condition is fulfilled; otherwise, the result is zero.

The result can be processed further, for example, with a subsequent jump command. Variable X2 remains unchanged.

Structure

Command structure Mxxx CPGE X1 >= X2	Mxxx:	Label (optional)
	X1:	Variable (result)
	X2:	Variable or constant

Example 1

```
SET H0 = 13
SET H1 = 50
CPGE H0  > = H1
```

After the program has been processed, H0 has the value zero and H1 the value 50.

Example 2

```
SET H0 = -3
CPGE H0  > = -3
```

After the program has been processed, H0 has the value one.

CPGT/COMPARE GREATER THAN

The CPGT command compares, observing the signs, whether variable X1 is greater than the variable or constant X2. Variable X1 contains the result. It is not equal to zero if the condition is fulfilled; otherwise, the result is zero.

The result can be processed further, for example, with a subsequent jump command. Variable X2 remains unchanged.

Structure

Command structure		
Mxxx CPGT X1 > X2	Mxxx:	Label (optional)
	X1:	Variable (result)
	X2:	Variable or constant

Example 1

```
SET H0 = -3
CPGT H0  >  -3
```

After the program has been processed, H0 has the value zero.

Example 2

```
SET H0 = 3
SET  H2  = 2
CPGT H0  >  H2
```

After the program has been processed, H0 has the value one.

CPLE/COMPARE LESS OR EQUAL

The CPLE command compares, observing the signs, whether variable X1 is less than or equal to the variable or constant X2. Variable X1 contains the result. It is not equal to zero if the condition is fulfilled; otherwise, the result is zero.

The result can be processed further, for example, with a subsequent jump command. Variable X2 remains unchanged.

Structure

Command structure		
Mxxx CPLE X1 <= X2	Mxxx:	Label (optional)
	X1:	Variable (result)
	X2:	Variable or constant

Example 1

```
SET H0 = 50
SET H1 = 13
CPLE H0  <= H1
```

After the program has been processed, H0 has the value zero and H1 the value 13.

Example 2

```
SET H0 = -3
CPLE H0  <= -3
```

After the program has been processed, H0 has the value one.

CPLT/COMPARE LESS THAN

The CPLT command compares, observing the signs, whether variable X1 is less than as variable or constant X2. Variable X1 contains the result. It is not equal to zero if the condition is fulfilled; otherwise, the result is zero.

The result can be processed further, for example, with a subsequent jump command. Variable X2 remains unchanged.

Structure

Command structure		
Mxxx CPLT X1 < X2	Mxxx:	Label (optional)
	X1:	Variable (result)
	X2:	Variable or constant

Example 1

```
SET H0 = -3
CPLT H0  < -3
```

After the program has been processed, H0 has the value zero.

Example 2

```
SET H0 = 2
SET  H2  = 3
CPLT H0  < H2
```

After the program has been processed, H0 has the value one.

CPNE/COMPARE NOT EQUAL

The CPNE command compares, observing the signs, whether variable X1 is not equal to the variable or constant X2. Variable X1 contains the result. It is not equal to zero if the condition is fulfilled; otherwise, the result is zero.

The result can be processed further, for example, with a subsequent jump command. Variable X2 remains unchanged.

Structure

Command structure		
Mxxx CPNE X1 != X2	Mxxx:	Label (optional)
	X1:	Variable (result)
	X2:	Variable or constant

Example 1

```
SET H0 = 13
SET H1 = 13
CPNE H0  != H1
```

After the program has been processed, H0 has the value zero and H1 the value 13.

Example 2

```
SET H0 = 50
CPNE H0  != 13
```

After the program has been processed, H0 has the value one.

23.10.2 Logical operations ANDL / ORL / NOTL

ANDL LOGICAL AND

The ANDL command is the logical AND operation of two variables. The result is written to variable X1. Variable X2 remains unchanged. The result is zero when one of the two variables = 0. The result is one when both variables != 0.

Structure

Command structure		
Mxxx ANDL X1 && X2	Mxxx:	Label (optional)
	X1:	Variable (result)
	X2:	Variable

Example 1

```
SET H01 = 100
SET H02 = 0
ANDL H01  && H02
```

After the program has been processed, H01 has the value zero.

Example 2

```
SET H01 = 100
SET H02 = 50
ANDL H01  && H02
```

After the program has been processed, H01 has the value one.

ORL/LOGICAL OR

The ORL command is the logical OR operation of two variables. The result is written to variable X1. Variable X2 remains unchanged. The result is one when one of the two variables != 0. The result is zero when both variables = 0.

Structure

Command structure		
Mxxx ORL X1 ¦¦ X2	Mxxx:	Label (optional)
	X1:	Variable (result)
	X2:	Variable

Example 1

```
SET H01 = 100
SET H02 = 0
ORL  H01  ¦¦ H02
```

After the program has been processed, H01 has the value one.

Example 2

```
SET H01 = 0
SET H02 = 0
ORL  H01  ¦¦ H02
```

After the program has been processed, H01 has the value zero.

NOTL/LOGICAL NOT

The NOTL command carries out the logical negation of a variable. The result is written to variable X1. Variable X2 remains unchanged. The result is one when variable X2 = 0. The result is zero when variable X2 != 0.

Structure

Command structure		
Mxxx NOTL X1 = NOT (X2)	Mxxx:	Label (optional)
	X1:	Variable (result)
	X2:	Variable

Example 1

```
SET H02 = 100
NOTL  H01  NOT (H02)
```

After the program has been processed, H01 has the value zero.

Example 2

```
SET H02 = 0
NOTL  H01  NOT (H02)
```

After the program has been processed, H01 has the value one.

24 Assembler – Examples

24.1 "Flashing light" sample program

24.1.1 Sample "Controller"

This sample program switches digital output DOØ1 on and off every 2 seconds.

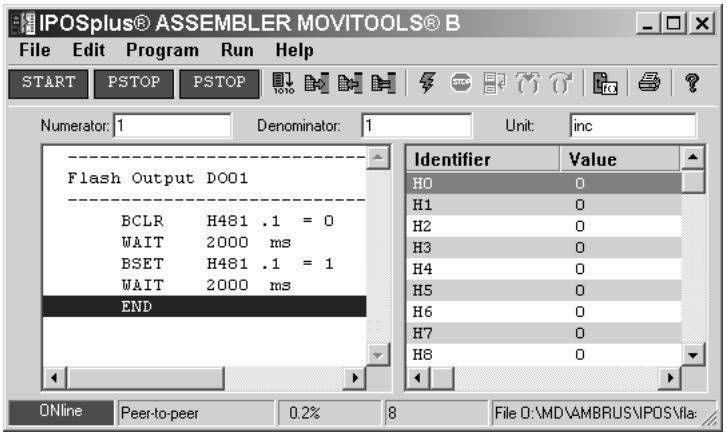
Quick-start (example)

Requirements

Mains connection and/or 24 V supply (backup voltage terminals X10:9 (+24 V / VI24) and X10:10 (0 V / DGND)) connected; no need to connect the motor and encoder (no motor movement).

1. No startup required for the speed control.
2. Set the output in Shell (P621 Binary output DOØ1 → IPOS OUTPUT).
3. Start the Assembler
4. Open/activate the "Program" window and enter the sample program "Flash output DOØ1".
5. Download the sample program from the program window (PC) to the inverter's program memory: Press "Ctrl + F9" in the active program window
6. Start the sample program: Press "F9" in the active program window
7. Check the user program:
   - The task 1 display in the program header changes from PSTOP to START.
   - The program pointer runs in the program window.
   - In Shell, the display parameter P052, output terminal DOØ1, changes between 1 and 0 every 2 seconds.

Assembler program window:



516819723

The program consists of:
3 remark lines (two dashed lines to highlight the program name, and one line for the program name)
Set output DO02 (X13:3) to "0"
Wait 2 seconds
Set output DO02 (X13:3) to "1"
Wait 2 seconds
End of program / jump to start of program

24.1.2 Sample "Positioning"

This sample program alternates the position of the drive 10 motor revolutions CW and CCW every 2 s.

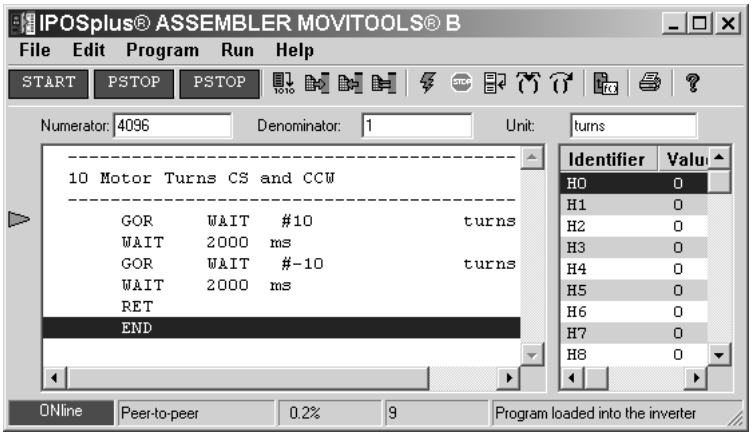
Quick-start (example)

Requirements

- Inverter / motor / encoder connected
- Inverter started up in VFC-n-Reg. & IPOS, CFC & IPOS or SERVO & IPOS (P700) operating mode in accordance with the MOVIDRIVE® system manual. P700 must have one of the settings after startup.
- Check the hardware limit switches of the Emergency switching off circuit

1. Parameter setting:
   - P600 binary input DI01 → ENABLE/STOP
   - P601 binary input DI02 → NO FUNCTION
   - P602 binary input DI03 → NO FUNCTION
   - P603 binary input DI04 → /LS CW
   - P604 binary input DI05 → /LS CCW
   - P700 operating mode → (VFC-n-Reg. / CFC / SERVO) & IPOS
   - NUMERATOR →4096
   - DENOMINATOR →1
   - UNIT→ rev.
2. Enter "10 motor revolutions back and forth" sample program.
3. Download the sample program: Press "F2" in the active program window
4. Drive must not reach the limit switches. Terminals DIØ4 (X13:5) and DIØ5 (X13:6) must have the level "1".
5. Start the sample program: Press "F9" in the active program window
6. Check the sample program:
   - The task 1 display in the program header changes from PSTOP to START.
   - The motor moves 10 revolutions CW or CCW alternately every two seconds.
   - The change in position can be tracked in display parameter P003.
   - The position setpoint and actual position are displayed in the variables H492 and H511.

"10 motor revolutions back and forth" sample program:



516923787

The program consists of:
3 remark lines
Travel relative 10 motor revolutions CW
Wait 2 seconds
Travel relative 10 motor revolutions CCW
Wait 2 seconds
End program
End of program / jump to start of program

The RET command is not mandatory in this example as the program was not called as a subroutine. The return command causes the program to jump back to the first program line, which is permitted in this case.

24.2 "Hoist" sample program

24.2.1 Characteristics

- Reference travel
- Selection of three hoist positions via binary inputs
- Notification when a selected position is reached
- Automatic movement away from hardware limit switches

The first 3 input terminals of the DIO11B option allow for 3 positions to be approached.

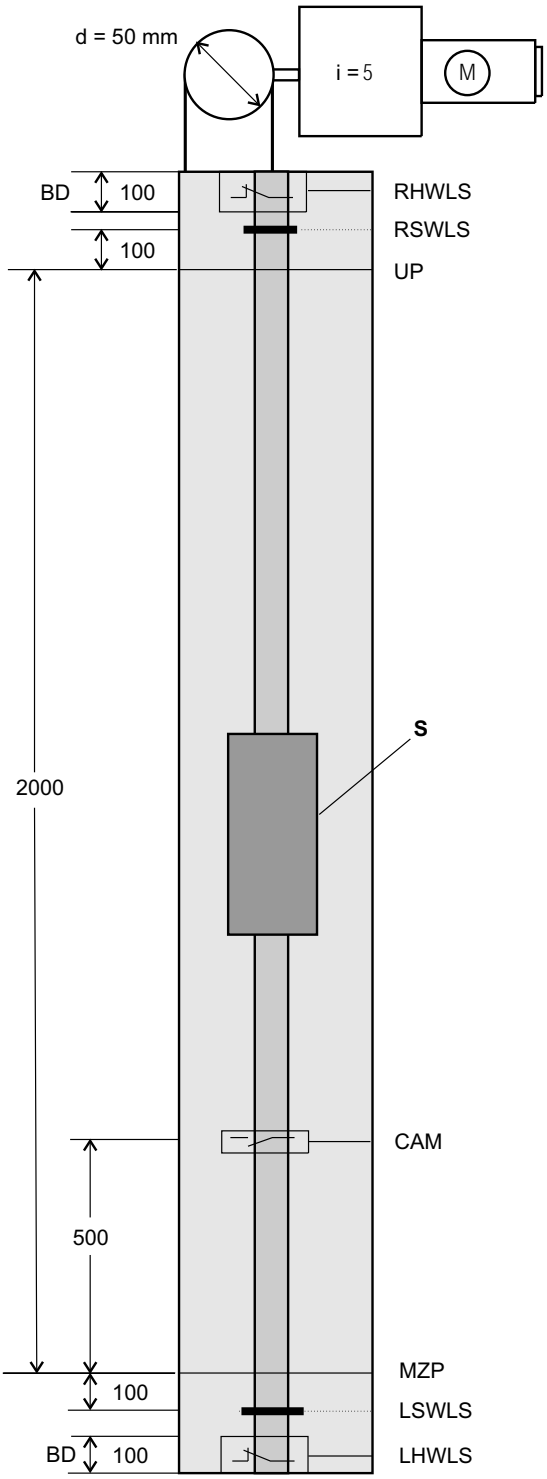
The drive is moved away from a hardware limit switch by entering a "1" signal at the "RESET" input (DI02).

24.2.2 Settings

A detailed description of the configuration of inputs/outputs is available in the remark section of the program source code.

24.2.3 Schematic structure

Schematic structure of the hoist with IPOS$^{plus®}$:

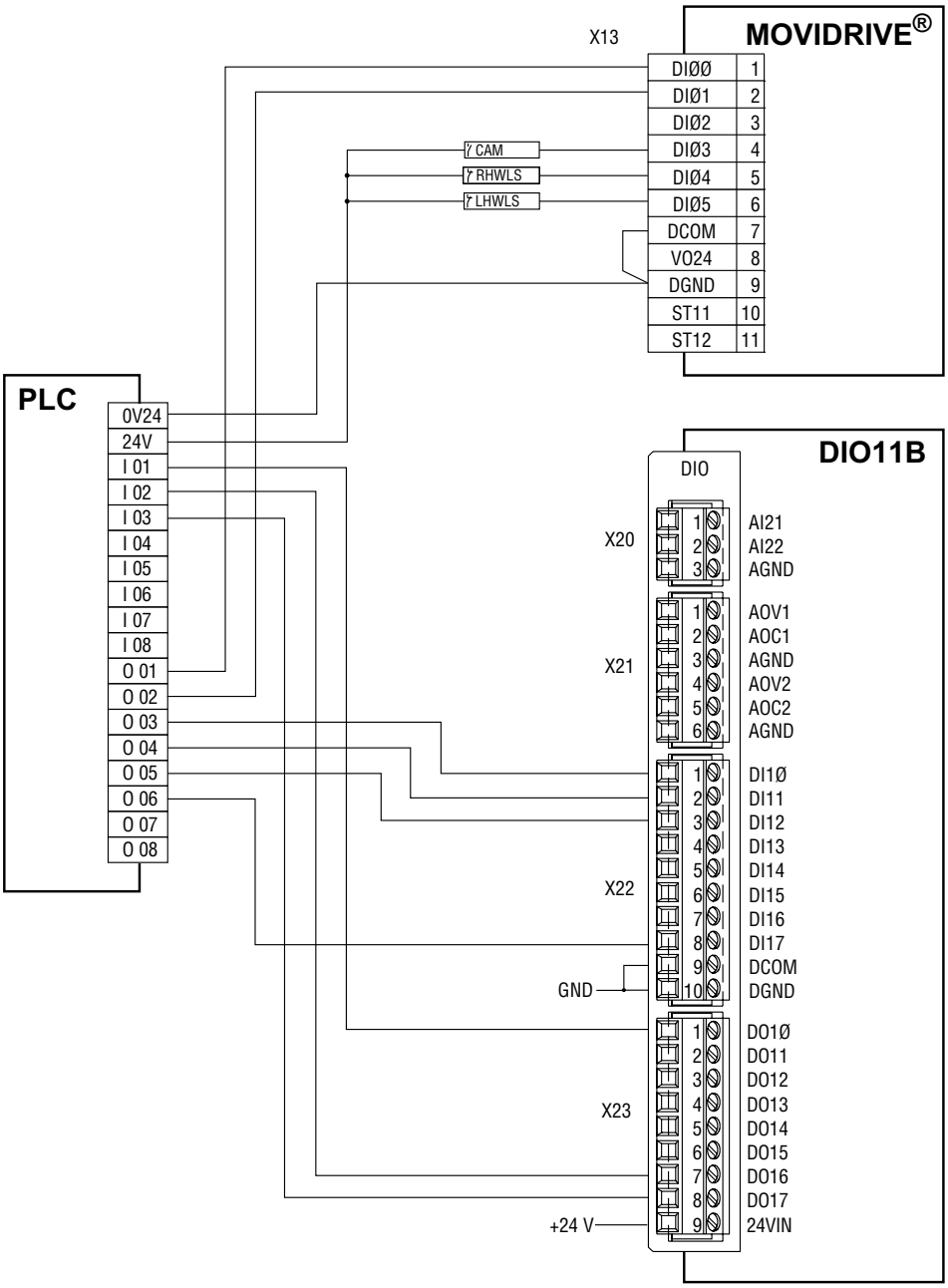


516940939

BD = braking distance
RHWLS = CW hardware limit switch
RSWLS = CW software limit switch
UP = upper travel range
S = travel carriage
CAM = Reference cam
MZP = Machine zero
LSWLS = CCW software limit switch
LHWLS = CCW hardware limit switch

24.2.4 Terminal wiring

Wiring diagram IPOS$^{plus®}$



516945803

PLC	= external controller	DI04	= /CW limit switch	DI16	= Start reference travel
DI00	= /Controller inhibit	DI05	= /CCW limit switch	DI17	= Start positioning
DI01	= Enable	DI10	= Position 1	DO10	= /Malfunction
DI02	= Reset	DI11	= Position 2	DO16	= IPOS IN POSITION
DI03	= Reference cam	DI12	= Position 3	DO17	= IPOS REFERENCE

24.2.5 Setting parameters relevant to the example

Group	Parameter	Setting
30_ Limits	P302 Maximum speed 1 [rpm] P350 Change direction of rotation	1500 OFF
60_ Binary inputs basic unit	P600 Binary input DI01 P601 Binary input DI02 P602 Binary input DI03 P603 Binary input DI04 P604 Binary input DI05	ENABLE/STOP RESET REFERENCE CAM /LS CW /LS CCW
61_ Binary inputs DIO11 option	P610 Binary input DI10 ... P617 Binary input DI17	IPOS INPUT ... IPOS INPUT
63_ Binary outputs DIO11 option	P630 Binary output DO10 P636 Binary output DO16 P637 Binary output DO17	/FAULT IPOS IN POSITION IPOS REFERENCE
7__ Control functions	P700 Operating mode P730 Brake function	CFC & IPOS YES
9__ IPOS Parameter	P900 Reference offset [mm] P901 Reference speed 1 [rpm] P902 Reference speed 2 [rpm] P903 Reference travel type P910 Gain X controller P911 Positioning ramp 1 [s] P912 Positioning ramp 2 [s] P913 Positioning speed CW [rpm] P914 Positioning speed CCW [rpm] P915 Velocity precontrol [%] P916 Ramp type P920 SW limit switch CW [mm] P921 SW limit switch CCW [mm] P922 Positioning window [inc] P923 Lag error window [inc] P930 Override	500 200 50 1 2.8 1 1 1350 1350 100 SINE 2100 -100 50 5000 OFF
Travel distance factor NUMERATOR/DENOMINATOR	Travel distance factor NUMERATOR Travel distance factor DENOMINATOR Unit	2048000 15708 mm

24.2.6 Calculating the IPOS$^{plus®}$ parameters

SW limit switch see schematic structure

Travel distance factor numerator

The travel dimension unit should be set to mm!

Number of increments per revolution of the drive wheel

Incr./motor rev. × gear ratio

4096 incr. × 5 = 20480

20480 × 100 (expansion factor) = 2048000

Travel distance factor denominator

Circumference of the drive wheel in mm

d × π

50 mm × π =157.0796327

157,08 × 100 (expansion factor) = 15708

Unit

The unit after the travel-specific information is to be displayed in mm.

Travel speed

1350 rpm

Position window

The message "Drive in position" should be issued when the target position ± 50 increments is reached.

24.2.7 Input terminals

Level	Terminal	terminal function	Meaning
0	DI00	/Controller inhibit	Switch power section on/off
0	DI01	Enable	Controlled standstill
0	DI02	Reset	Reset after fault (moving clear of limit switches)
0	DI03	Reference cam	Switch for zero or offset value
0	DI04	Limit switch right	Limit switch for stopping (+)
0	DI05	Limit switch left	Limit switch for stopping (-)
0	DI10	IPOS input	Hoist position 0 mm
0	DI11	IPOS input	Hoist position 1000 mm
0	DI12	IPOS input	Hoist position 2000 mm
0	DI13	IPOS input	-
0	DI14	IPOS input	Jog positive
0	DI15	IPOS input	Jog negative
0	DI16	IPOS input	Start reference travel
0	DI17	IPOS input	Start positioning

24.2.8 Output terminals

Level	Terminal	Unit	terminal function	Meaning
0	DB00	MDX	/Brake	Brake control via auxiliary relay
0	DO01	MDX	Ready	Controller active, power supply to electronics OK
0	DO02	MDX	/Fault	no fault
0	DO10	DIO11B	IPOS output	-
0	DO11	DIO11B	IPOS output	-
0	DO12	DIO11B	IPOS output	-
0	DO13	DIO11B	IPOS output	-
0	DO14	DIO11B	IPOS output	-
0	DO15	DIO11B	IPOS output	-
0	DO16	DIO11B	IPOS in position	Drive in positioning window
0	DO17	DIO11B	IPOS reference	Reference travel successfully completed

24.2.9 Program source code (with remarks)

NUMERATOR: 2048000 DENOMINATOR: 15708 UNIT: mm ********** Program: hoist With the first 3 inputs of the option DIO11A, the drive moves to position 0;1000;2000. File: Hub 100.mdx Author: SEW/AWT Date: 01.06.98 Changed: 01.06.98 Terminal wiring of inputs:---------- DI00 Controller inhibit DI01 Enable DI02 Reset (move LS clear) DI03 Reference cam DI04 = CW limit switch DI05 CCW limit switch DI10 Hoist position 0 mm DI11 " 1000 mm DI12 " 2000 mm DI13 - - - DI14 (Jog CW) DI15 (Jog CCW) DI16 Reference travel DI17 Start positioning Terminal wiring of outputs:---------- DB00 Brake DO01 Ready signal DO16 "IPOS in position" DO17 "IPOS reference"	Comment
---------- Program start ========== Program branch distributor ========== SETINT ERROR M10 M100: CALL M50 JMP LO I0001000000000000, M101 CALL M20 M101: JMP LO I0000010000000000, M102 CALL M30 M102: JMP LO I0000100000000000, M103 CALL M40 M103: JMP UNCONDITIONED , M100 ----------	Program branch distributor Activate interrupt routine for hardware limit switch processing Reset/move clear of limit switch → Main program DI16 = 1 → Reference travel DI15 = 1 → Jog CW DI14 = 1 → Jog CCW
Subroutine/move clear of limit switch ========== M10: JMP HI I0000000000110000, M1 M3: JMP HI I0000000000110000, M2 ASTOP IPOS ENABLE JMP UNCONDITIONED , M3 M2: ASTOP TARGET POSITION M1 : RET ----------	Reset/move clear of limit switch If drive has not moved onto limit switch (DI04/DI05 Limit switch CW/CCW), then return to branch distributor. If it has, then unlock travel and wait until drive has moved clear of limit switch (DI02 – input terminal function "Reset") Then stop drive by setting target position to current position

`Reference subroutine`
`==========`
`M20: ASTOP IPOS ENABLE`
`GO0 U,NW, ZP`
`M22: JMP LO I0000000000000001, M21`
`SET H319 = 0`
`BMOV H319.0 = H473.20`
`JMP H319 == 0 , M22`
`M21 : ASTOP TARGET POSITION`
`RET`
`----------`
	Reference travel
	
	Travel release
	Reference travel, no wait, start at zero pulse,
	Cancel reference travel
	and the bit in the status word "IPOS Reference" = 0

`(subroutine jog mode)`
`==========`
`M30: RET`
`M40: RET`
`----------`
	Option: Subroutine (e.g. jog mode)
	Jog CW
	Jog CCW
	See next example.

`Main program: Hoist positioning`
`==========`
`M50: JMP LO I0000000001000000, M51`
`GOA WAIT #0 mm`
`M51: JMP LO I0000000010000000, M52`
`GOA WAIT #1000 mm`
`M52: JMP LO I0000000100000000, M53`
`GOA WAIT #2000 mm`
`M53: RET`
`----------`
`END`
	Main program: Hoist positioning
	
	If input DI10 is set, move to position 0 mm
	If input DI11 is set, move to position 1000 mm
	If input DI12 is set, move to position 2000 mm

24.3 "Jog mode" sample program

24.3.1 Characteristics

- Travel in two directions with binary inputs "Jog+/Jog-.
- Adjustable travel speeds and ramps.
- Endless travel possible.
- No reference travel required.
- Compliance with travel range limits (software limit switches).
- Automatic movement away from hardware limit switches.

Endless movement is possible in two directions using two binary inputs Jog+ (DI14) and Jog- (DI15). No reference travel required. If the drive has been referenced and the software limit switches set, travel only takes place within these limits. Movement only takes place when there is a "1" signal at one of the jog terminals. The drive is moved away from a hardware limit switch by entering a "1" signal at the RESET input (DI02).

24.3.2 Settings

The detailed configuration of the inputs/outputs and the variables used in the program is documented in the remark section of the program source code.

24.3.3 Input terminals

Level	Terminal	terminal function	Meaning
0	DI00	/Controller inhibit	Switch power section on/off
0	DI01	Enable	Controlled standstill
0	DI02	Reset	Reset after fault (moving clear of limit switches)
0	DI03	Reference cam	Switch for zero or offset value
0	DI04	Limit switch right	Limit switch for stopping (+)
0	DI05	Limit switch left	Limit switch for stopping (-)
0	DI10	IPOS input	-
0	DI11	IPOS input	-
0	DI12	IPOS input	-
0	DI13	IPOS input	-
0	DI14	IPOS input	Jog positive
0	DI15	IPOS input	Jog negative
0	DI16	IPOS input	Start reference travel
0	DI17	IPOS input	Start positioning

24.3.4 Output terminals

Level	Terminal	Unit	terminal function	Meaning
0	DB00	MDX	/Brake	Brake control via auxiliary relay
0	DO01	MDX	Ready	Controller active, power supply to electronics OK
0	DO02	MDX	/Fault	no fault
0	DO10	DIO11B	IPOS output	-
0	DO11	DIO11B	IPOS output	-
0	DO12	DIO11B	IPOS output	-
0	DO13	DIO11B	IPOS output	-
0	DO14	DIO11B	IPOS output	-
0	DO15	DIO11B	IPOS output	-
0	DO16	DIO11B	IPOS in position	Drive in positioning window
0	DO17	DIO11B	IPOS reference	Reference travel successfully completed

24.3.5 Program source code (with remarks)

NUMERATOR: 1 DENOMINATOR: 1 UNIT: Inc ********** Sample program: Jog mode File: Tipp.mdx Author: SEW/AWT Date: 01.06.98 Function: Jog mode - endless travel possible - No need to reference the axis - Travel limits are observed; software LS - Travel speeds/ramps from H310 - Inputs jog+ (DI14)/jog- (DI15) Parameter setting (P600) of inputs/outputs: In inverter commas = specified function without inverted commas = IPOS INPUT/OUTPUT Terminal wiring of inputs:---------- DI00 "Controller inhibit" DI01 "Enable" DI02 "Error reset" (move LS clear) DI04 "Reference cam" DI03 "CW limit switch" DI05 "CCW limit switch" DI14 Jog CW DI14 Jog CCW DI16 Start reference travel DI17 (Start positioning) Terminal wiring of outputs---------- DB00 Brake DO01 Ready signal DO16 "IPOS in position" DO17 "IPOS reference" Variables used:---------- H310 = V-jog CW (1/10 rpm) H311 = "CCW" H312 = acceleration ramp (ms) H313 = deceleration ramp (ms) H316 - H319 = jog auxiliary variable ********** ----------	Comment
Program start ========== Initialization ---------- SET H310 = 5000 SET H311 = 5000 SET H312 = 2000 SET H313 = 2000 ----------	Set velocity and acceleration values for jog mode (see remark)

Program branch distributor ========== SETINT ERROR M10 M100: JMP LO I0001000000000000, M101 CALL M20 M101: JMP LO I0000010000000000, M102 CALL M30 M102: JMP LO I0000100000000000, M103 CALL M40 M103: JMP UNCONDITIONED , M100 ----------	Program branch distributor Activate interrupt routine for hardware limit switch processing reset/move clear of limit switch DI16 = 1 → Reference travel DI15 = 1 → Jog CW DI14 = 1 → Jog CCW
Subroutine/move clear of limit switch ========== M10: JMP HI I0000000000110000, M1 M3: JMP HI I0000000000110000, M2 ASTOP IPOS ENABLE JMP UNCONDITIONED , M3 M2: ASTOP TARGET POSITION M1 : RET ----------	Reset/move clear of limit switch If there is no contact with the limit switch (DI05/DI06 LS CW/CCW), return to branch distributor. If it has, then unlock travel and wait until drive has moved clear of limit switch (parameterized "Reset" input function DI02). Then stop drive by setting target position to current position.
Reference subroutine ========== GO0 U,NW, ZP M20: ASTOP IPOS ENABLE M22: JMP LO I0000000000000001, M21 SET H309 = 0 BMOV H309.0 = H473.20 JMP H309 == 0 , M22 M21 : ASTOP TARGET POSITION RET ----------	Reference travel Travel release Reference travel, do no wait, start at zero pulse as long as "Controller inhibit" = 0 and the bit in the status word "IPOS Reference" = 0
Subroutine jog mode ========== Jog mode (query: Is software limit switch active) ---------- M35 : SETSYS POS.SPEED C(C)W = H310 SETSYS POS. RAMP = H312 SET H319 = 0 BMOV H319.0 = H473.20 JMP H319 == 0 , M36 SET H319 = H496 OR H319 | H497 JMP H319 == 0 , M36 SET H319 = 1 SET H317 = H496 SET H318 = H497 M36 : RET	Jog mode Query: Is software limit switch active Set velocity Set ramp time Query: has the axis been referenced (software limit switch active) Query: both software ranges = 0 (software limit switch not active) if software limit switch active, set flag H319=1 and load jog travel variables (H317) with the software travel ranges (system variables H496 and H497)

----------	Jog CW Move for as long as DI14 = 1 and DI15 = 0, Query: Is software limit switch active? Add 1000 motor revolutions to the current actual position and use the result as the new target position
Jog +	

M30: JMP LO I0000010000000000, M31	
JMP HI I0000100000000000, M31	
CALL M35	
JMP H319 == 1 , M32	
GETSYS H317 = ACT.POSITION	
ADD H317 + 4096000	
M32 : ASTOP IPOS ENABLE	
GOA NOWAIT H317	
JMP UNCONDITIONED , M30	
M31 : ASTOP TARGET POSITION	
RET	

Jog -	

M40: JMP LO I0000100000000000, M41	Jog CCW Move for as long as DI14 = 0 and DI15 = 1, Query: Is software limit switch active? Add 1000 motor revolutions to the current actual position and use the result as the new target position
JMP HI I0000010000000000, M41	
CALL M35	
JMP H319 == 1 , M42	
GETSYS H318 = ACT.POSITION	
SUB H318 - 4096000	
M42 : ASTOP IPOS ENABLE	
GOA NOWAIT H318	
JMP UNCONDITIONED , M40	
M41 : ASTOP TARGET POSITION	
RET	

Jog mode end	

END	

24.4 "Table positioning" sample program

24.4.1 Characteristics

- Binary coded selection of 16 table positions.
- Binary coded output of the currently selected table positioning.
- Clear message when selected table position has been reached.
- Automatic movement away from hardware limit switches.

The first 4 binary inputs of the DIO11B option can be used for selecting 16 table positions (travel variables H000 ... H015) in binary coded format. When a travel variable number is selected (table pointer), it is always represented at the first 4 binary inputs of the DIO11A in binary coded format.

Reference movement must be activated using input DI16 "Reference travel" before you can move the drive to table positions. You can use input DI17 "Start positioning" to enable/interrupt the travel job (with "Controller inhibit" and "Enable" = "1" signal). When a new table position is selected, it is advisable to set input DI17 to a "0" signal until it is certain that all the bits of the table pointer have been set.

A "1" signal at output DO15 "Table position valid" indicates that the selected table position has been reached. This output is reset once a new table position is selected. By additionally evaluating output DO16 "IPOS in position", it is also possible to detect when the selected table position is exited even when the controller is deactivated ("Controller inhibit" = "0").

The drive is moved away from a hardware limit switch by entering a "1" signal at the RESET input (DI02).

24.4.2 Settings

The detailed configuration of the inputs/outputs (see below) and the variables used in the program is documented in the remark section of the program source code.

The table positions can be written via the variable window of the Assembler or with the keypad in the variables (H00 ... H15). The variables are stored in the non-volatile memory.

	INFORMATION The user travel units numerator and denominator in the position window header are not relevant here because the position values of travel variables are always evaluated in increments (4096 increments/motor revolution).

24.4.3 Input terminals

Level	Terminal	terminal function	Meaning
0	DI00	/Controller inhibit	Switch power section on/off
0	DI01	Enable	Controlled standstill
0	DI02	Reset	Reset after fault (moving clear of limit switches)
0	DI03	Reference cam	Switch for zero or offset value
0	DI04	Limit switch right	Limit switch for stopping (+)
0	DI05	Limit switch left	Limit switch for stopping (-)
0	DI10	IPOS input	Variable pointer bit 2'0
0	DI11	IPOS input	Variable pointer bit 2'1
0	DI12	IPOS input	Variable pointer bit 2'2
0	DI13	IPOS input	Variable pointer bit 2'3
0	DI14	IPOS input	Jog positive
0	DI15	IPOS input	Jog negative
0	DI16	IPOS input	Start reference travel
0	DI17	IPOS input	Start positioning

24.4.4 Output terminals

Level	Terminal	Unit	terminal function	Meaning
0	DB00	MDX	/Brake	Brake control via auxiliary relay
0	DO01	MDX	Ready	Controller active, power supply to electronics OK
0	DO02	MDX	/Fault	no fault
0	DO10	DIO11B	IPOS output	Variable pointer bit 2'0
0	DO11	DIO11B	IPOS output	Variable pointer bit 2'1
0	DO12	DIO11B	IPOS output	Variable pointer bit 2'2
0	DO13	DIO11B	IPOS output	Variable pointer bit 2'3
0	DO14	DIO11B	IPOS output	-
0	DO15	DIO11B	IPOS output	Table position valid
0	DO16	DIO11B	IPOS in position	Drive in positioning window
0	DO17	DIO11B	IPOS reference	Reference travel successfully completed

24.4.5 Program source code (with remarks)

NUMERATOR: 1 DENOMINATOR: 1 UNIT: Inc ********** Program: Table positioning File: Tab.mdx Author: SEW/AWT Date: 01.06.98 Function: Table positioning: - The first 4 inputs of the DIO11 option are used to select the positions in the corresponding variables 0-15 in binary coded format. -Input DI17 (X22:17) is used to enable the selected travel command Parameterization of inputs/outputs: In inverter commas = specified function without inverted commas = IPOS INPUT/OUTPUT Terminal wiring of inputs:---------- DI00 "Controller inhibit" DI01 "Enable" DI02 "Error reset" (move LS clear) DI03 "Reference cam" DI04 "CW limit switch" DI05 "CCW limit switch" DI10 Variable pointer bit 2'0 DI11 2'1 DI12 2'2 DI13 2'3 DI14 (Jog CW) DI15 (Jog CCW) DI16 Start reference travel DI17 Start positioning Terminal wiring of outputs---------- DB00 Brake DO01 Ready signal DO10 Variable pointer bit 2'0 DO11 2'1 DO12 2'2 DO13 2'3 DO14 - DO15 Table position reached DO16 "IPOS in position" DO17 "IPOS reference" Variables used:---------- H300 = Travel speed CW (1/10 rpm) H301 = Travel speed CCW (1/10 rpm) H302 = acceleration ramp CW (ms) H303 = deceleration ramp CCW (linear) H320 - H324 = auxiliary variables ********** ----------	Comment

Program start ========== Initialization ---------- SET H300 = 15000 SET H301 = 15000 SET H302 = 1000 SET H303 = 1000 ----------	Set speed and acceleration values for table positioning (see variable description in the remarks for the program source code)
Program branch distributor ========== SETINT ERROR M10 M100: CALL M50 JMP LO I0001000000000000, M101 CALL M20 M101: JMP LO I0000010000000000, M102 CALL M30 M102: JMP LO I0000100000000000, M103 CALL M40 M103: JMP UNCONDITIONED , M100 ----------	Program branch distributor Activate interrupt routine for hardware limit switch processing reset/move clear of limit switch → main program DI16 = 1 → Reference travel DI14 = 1 → Jog CW DI15 = 1 → Jog CCW
Subroutine/move clear of limit switch ========== M10: JMP HI I0000000000110000, M1 M3: JMP HI I0000000000110000, M2 ASTOP IPOS ENABLE JMP UNCONDITIONED , M3 M2: ASTOP TARGET POSITION M1 : RET ----------	Reset/move clear of limit switch If drive has not moved onto limit switch (DI04/DI05 Limit switch CW/CCW), then return to branch distributor. If it has, then unlock travel and wait until drive has moved clear of limit switch (parameterized "Reset" input function DI02). Then stop drive by setting target position to current position
Reference subroutine ========== M20: ASTOP IPOS ENABLE AND H480 & FFFFFFF0 hex BCLR H480.5 = 0 GO0 U,NW, ZP M22: JMP LO I0000000000000001, M21 SET H319 = 0 BMOV H319.0 = H473.20 JMP H319 == 0 , M22 M21 : ASTOP TARGET POSITION RET ----------	Reference travel Travel release Delete output binary coded table position Delete output "Table position valid" Reference travel, no wait, start at zero pulse, as long as "Controller inhibit" = 0 and the bit in the status word "IPOS Reference" = 0
Subroutine jog mode ========== M30: RET M40: RET	Option: Subroutine (e.g. jog mode) Jog CW Jog CCW

Main program table positioning ========== Check for referenced axis ----------	Main program table positioning Table positions are only approached with a referenced drive (DO17 = 10 bit position in output terminal system variable H473; parameter set to "IPOS reference")
M50: SET H321 = 0 BMOV H321.0 = H473.20 JMP H321 != 0, M51 RET ---------- Set travel velocity and ramp ----------	Set travel speed, acceleration and deceleration ramp
M51: SETSYS POS.SPEED C(C)W = H300 SETSYS POS. RAMP = H302 ---------- Read in variable pointer in variable H320 ----------	Select table pointer (travel variable no.) binary coded with 4 inputs (DI10 - DI13)
SET H320 = H483 ASHR H320 > > 6 AND H320 & F hex ---------- Check output "Table position reached" ----------	Reset the output "Tab. position valid" if the table pointer has been changed. Store current table pointer in comparison variable.
JMP H322 == H320, M54 BCLR H480.5 = 0 M54 : SET H322 = H320 ---------- Output binary coded variable pointer ----------	Write selected table pointer to output terminals (DO10 – DO13) without altering other outputs of the output variable (H480)
SET H323 = H320 SET H324 = H480 AND H324 & FFFFFFF0 hex OR H323 ¦ H324 SET H480 = H323 ----------	If DI17 = 1, then travel to position value of selected travel variable, otherwise stop drive
Enable table positioning ----------	Reset "Table position selection valid" signal Unlock travel
M53: JMP LO I0010000000000000, M52 ASTOP IPOS ENABLE GOA NOWAIT [H320] JMP NOT IN POSITION, M53 BSET H480.5 = 1 JMP UNCONDITIONED , M55 ----------	Move to table position until position is reached or DI17 = 0. Set "Table position selection valid" signal
M52: ASTOP HOLD CONTROL M55 : RET ---------- Table positioning end ---------- END	Stop drive

Index

A

Absolute encoder 53
absolute encoder (SSI) 138
Absolute encoder, actual position 35
ActPos_Abs / ACTPOS ABS....35
ActPos_Extt / ACTPOS EXT....35
ActPos_Mot / ACTPOS MOT....35
Actual position source....134
Actual position, absolute encoder 35
Actual position, external encoder....35
Actual position, motor encoder....35
AnaOutpIPOS / ANA. OUT IP....31
AnaOutpIPOS2 / ANA. OUT IP2....30
Automatic encoder replacement detection....137

B

Background color 154
Binary inputs, basic unit 32, 36
Binary outputs 30
Binary outputs, basic unit....31, 32, 36, 37
BREAK....283
Bus systems....17

C

Cam distance 126
CAN encoder 139
CCount_Ext....36
CCount_ExtOn....36
CCount_Mot....36
CCount_MotOn 36
Color, Background 154
Control word....33
Control word modulo function 29
ControlWord / CTRL. WORD 33
Copyright....15
Counting direction 138
Cycle frequency 139

D

Designated use 17
DIO11A, analog output 31
DIO11A, analog outputs....30
DIO11A, binary outputs....31
DIP11A, binary outputs 31
Directories....156
Directory, #include directives 156
DPRAM synchronization....141
DRS11A, binary inputs 30
DRS11A, status message....30
DRS_Ctrl / DRS CTRL....30
DRS_Status / DRS STATUS 30

E

Encoder scaling 139
Encoder scaling ext. encoder 135
Encoder type....53, 138
Error interrupt....46
Exclusion of liability....15
External encoder, actual position....35
External encoder, zero pulse 36
External encounter, C track 36

F

Fieldbus, setpoint position 35

G

Gain X controller 127

H

Hiperface offset X14 136

I

Incremental encoder 53
Incremental encoder simulation....53
InpLevelB / INPUT LVLB 36
INPUT LVL....32, 36
InputLevel / INPUT LVL 32
Interrupt activation 46
Interrupts....40, 45
Interrupt, error interrupt....46
Interrupt, timer0 interrupt 48
Interrupt, touch probe DI02 interrupt....47
IPOS counter 35
IPOS CTRL.W Task 1....132
IPOS CTRL.W Task 2....132
IPOS encoder 134
IPOS modulo function....140
IPOS monitoring 131
IPOS parameters 123
IPOS reference travel 123
IPOS setpoint....38

IPOS special functions 132
IPOS synchronization 141
IPOS travel parameters 127
IPOS variable edit 134
IPOS_Setp / IPOS_SETP 38

J

Jerk time 132

L

Lag distance 34
Lag error window 131
Lag window 34
LagDistance / LAG DISTAN 34
LagWindow / LAG WINDOW 34
Liability for defects 15

M

ModActPos / MOD.ACTPOS 29
ModCount / MOD COUNT 29
ModTagPos / MOD.TAGPOS 29
Modulo Actual Position 29
Modulo denominator 140
Modulo encoder resolution 140
Modulo function 73, 140
Modulo function, control word 29
Modulo numerator 29, 140
Modulo Target Position 29
ModuloCtrl / MODULOCTRL 29
Motor encoder, actual position 35
Motor encoder, C track 36
Motor encoder, zero pulse 36

O

Operating state 283
OptOutpIPOS / OPT. OUT IP 31
OutpLevelB / OUTPUT LVLB 37
Output directory 156
OutputLevel / OUTPUT LVL 32
Override 132

P

Parameter description
  P9xx IPOS parameters 123
PID controller
  Actual value address 38
  Actual value offset 38
  Actual value scaling 38
  D component 38
  Filtered and scaled actual value 38
  I component 38
  Maximum actual value 38
  Maximum output value 38
  Maximum output value control variable 39
  Minimum actual value 38
  Minimum output value 38
  Minimum output value control variable 39
  Operating mode 38
  P component 38
  Precontrol 38
  Proportional component 38
  Setpoint 38
  Setpoint address 38
  Setpoint scaling 38
  Status word 39
PID_ActAdr / PID.ACTADR 38
PID_ActMax / PID.ACTMAX 38
PID_ActMin / PID.ACTMIN 38
PID_ActNorm / PID.ACTNOR 38
PID_ActOffset / PID.ACTOFF 38
PID_ActScale / PID.ACTSCA 38
PID_CmdAdr / PID.CMDADR 38
PID_CmdScale / PID.CMDSCA 38
PID_Command / PIDCOMMAND 38
PID_Feedf / PID.FEEDF 38
PID_K_p / PID.KP 38
PID_LimitMax / PID.LMTMAX 38
PID_LimitMin / PID.LMTMIN 38
PID_Mode / PID.MODE 38
PID_Outp_D / PID.OUTPD 38
PID_Outp_I / PID.OUTPI 38
PID_Outp_P / PID.OUTPP 38
PID_SetpMax / PID.SETMAX 39
PID_SetpMin / PID.SETMIN 39
PID_Status / PID.STATUS 39
Position offset 139
Position window 34, 131
Positioning interruption detection 131
Positioning ramp 1 127
Positioning ramp 2 127
PosWindow / POS. WINDOW 34
Processing time, task 43
PSTP 283

P9xx IPOS parameters 123
P90x IPOS reference travel 123
P900 Reference offset 123
P901 Reference speed 1 124
P902 Reference speed 2 124
P903 Reference travel type 124
P904 Reference travel to zero pulse....126
P905 Hiperface offset X15 126
P906 Cam distance....126
P91x IPOS travel parameters 127
P910 Gain X controller....127
P911 Positioning ramp 1 127
P912 Positioning ramp 2 127
P913/P914 Travel speed CW/CCW....127
P915 Velocity precontrol 127
P916 Ramp type 128
P917 Ramp mode 130
P918 bus setpoint source 130
P92x IPOS monitoring 131
P920 SW limit switch CW....131
P921 SW limit switch CCW....131
P922 Position window....131
P923 Lag error window 131
P924 Positioning interruption detection....131
P93x IPOS special functions....132
P930 Override....132
P931 IPOS CTRL word Task 1 132
P932 IPOS CTRL word Task 2 132
P933 Jerk time 132
P938 speed task 1 132
P939 speed task 2 133
P94x IPOS encoder 134
P940 IPOS variable edit....134
P941 actual position source....134
P942 / P943 encoder factor numerator / denominator 134
P944 Encoder scaling ext.encoder 135
P945 synchronous encoder type (X14)....135
P946 synchronous encoder counting direction (X14)....136
P947 Hiperface offset X14 136
P948 Automatic encoder replacement detection .137
P95x absolute encoder (SSI) 138
P950 encoder type....138
P951 counting direction 138
P952 cycle frequency....139
P953 position offset 139
P954 Zero offset 139
P955 encoder scaling 139
P956 CAN encoder baud rate....139
P96x IPOS modulo function....140
P960 Modulo function 140
P961 Modulo numerator 140
P962 Modulo denominator....140
P963 Modulo encoder resolution 140
P97x IPOS synchronization 141
P970 DPRAM synchronization 141
P971 synchronization phase....141

Q

Qualified person....17

R

Ramp mode 130
Ramp type 128
RecStatS1 / SBUS1REC 37
RecStatS2 / SBUS2REC 37
Reference offset 123
Reference speed 1 124
Reference speed 1/2 124
Reference speed 2 124
Reference travel to zero pulse....126
Reference travel type....124
RefOffset / REF. OFFSET 34
Resolver....53

S

Safety Notes 16
Safety notes....14
SCOPE 30
Scope474 / SCOPE 474 30
Scope475 / SCOPE 475 30
Setpoint position 34
Setpoint position, fieldbus....35
SetpointPos / SETP. POS. 34
SetpPosBus / SP. POS. BUS 35
SLS_left / SLS LEFT....34
SLS_right / SLS RIGHT 34
Software limit switch CCW....34
Software limit switch CW 34
Speed run 157
Speed task 1....132
Speed task 2....133
START 283
Status word SCOM 37
StatusWord / STAT. WORD 30
StdOutpIPOS / STD. OUT IP....31

STEP....283
Structure of the safety notes....14
SW limit switch CCW....131
SW limit switch CW....131
Synchronization phase....141
Synchronous encoder counting direction (X14)....136
Synchronous encoder type (X14)....135
Syntax display....154
Syntax highlighting....154

T

Target group....17
Target position....34
TargetPos / TARGET POS....34
Task implementation information....44
Task management....40
Task processing time....43
Task speed....157
Task 3....44
Tasks for MOVIDRIVE® A....43
Tasks for MOVIDRIVE® B....43
Timer0 interrupt....48
Timer_0 / TIMER 0....33
Timer_1 / TIMER 1....33
Timer_2 / TIMER 2....33
Touch probe....35
Touch probe DI02 interrupt....47
TpPos1_Abs / TP.POS1ABS....35
TpPos1_Ext / TP.POS1EXT....35
TpPos1_Mot / TP.POS1MOT....35
TpPos1_VE / TP.POS1VE....35
TpPos2_Abs / TP.POS2ABS....35
TpPos2_Ext / TP.POS2EXT....35
TpPos2_VE / TP.POS2VE....35
TP. POS1ABS....35
TP. POS1EXT....35
TP. POS1MOT....35
TP. POS2ABS....35
TP. POS2EXT....35
TP. POS2MOT....35
Travel speed CW/CCW....127
T0_Reload / T0 RELOAD....33

U

User timer....33
User watchdog....34

V

Variable interrupt request....38
Variable interrupts, MOVIDRIVE® B....49
Variable interrupt, call....49
Variable interrupt, IPOS access....50
VarIntReq / VARINTREQ....38
Velocity precontrol....127
Virtual encoder....35

W

Watchdog, WdogTimer / WD. TIMER....34

Z

Zero offset....139

Symbole

_GetSys....182, 214
_MoviLink....182, 223, 309
_SBusCommDef....182, 231
_SetSys....182, 238
#include directory....156

SEW-EURODRIVE
Driving the world

SEW-EURODRIVE GmbH & Co KG
P.O. Box 3023
D-76642 Bruchsal/Germany
Phone +49 7251 75-0
Fax +49 7251 75-1970
sew@sew-eurodrive.com

➞ **www.sew-eurodrive.com**